Planning and Environmental Linkages Study Report

April 2020

I-25 Central PEL

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Acknowledgements

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List of Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADT	Average daily traffic
APCD	Air Pollution Control Division
APE	Area of potential effect
CAV	Connected and autonomous vehicle
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CML	Consolidated main line
CO	Carbon monoxide
CPW	Colorado Parks and Wildlife
Denver	City and County of Denver
DOI	U.S. Department of the Interior
DRCOG	Denver Regional Council of Governments
EA	Environmental Assessment
EIS	Environmental impact statement
ESA	Environmental site assessment
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HOV	High occupancy vehicle
HPTE	High Performance Transportation Enterprise
HSM	Highway Safety Manual
I-10	Interstate 10
I-25	Interstate 25
I-70	Interstate 70
I-90	Interstate 90
ISA	Initial site assessment
ITS	Intelligent transportation systems
LEP	Limited English proficiency
MESA	Modified environmental site assessment
mph	Miles per hour
MS4	Municipal separate storm sewer system

NEPA	National Environmental Policy Act
NO_2	Nitrogen dioxide
NPS	National Park Service
NRHP	National Register of Historic Places
OWJ	Official with jurisdiction
PEL	Planning and Environmental Linkages
PM	Particulate matter
ROW	Right of way
RTD	Regional Transportation District
RTP	Regional Transportation Plan
SB40	Senate Bill 40
SFG	Stakeholder Focus Group
SHPO	State Historic Preservation Office
SIP	State implementation plan
TDM	Transportation demand management
TIMP	Traffic incident management plan
TIP	Transportation improvement program
TRB	Transportation Research Board
UPRR	Union Pacific Railroad
US 6	U.S. Highway 6
US 36	U.S. Highway 36
US 85	U.S. Highway 85
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VIA	Visual Impact Assessment
vpd	Vehicles per day

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Executive Summary

Project Description and Location

This Interstate 25 (I-25) Central Planning and Environmental Linkages (PEL) Study documents the analysis and recommendations conducted to identify needed transportation improvements along a critical 4.5-mile stretch of I-25 within the heart of Downtown Denver, as seen in Figure 1. The PEL Study provides a long-term vision, developed through a collaborative process, for I-25 between Santa Fe Drive/U.S. Highway 85 (US 85) and 20th Street. Conducted by the Colorado Department of Transportation (CDOT) in partnership with the City and County of Denver (Denver), this vision will enable these agencies to plan, build, and manage the corridor's future traffic and development, while addressing immediate maintenance needs. It will enable the corridor to respond proactively to Metropolitan Denver's unprecedented growth and sustain its critical role in supporting the region's mobility and economic vitality.

Figure 1 I-25 Regional Location

PEL Recommendations

The I-25 Central PEL is recommending three alternatives (fully described in the Development and Evaluation of Alternatives chapter) for consideration in future National Environmental Policy Act (NEPA) processes. None of the three alternatives alone can individually address all needs of the corridor. Future NEPA studies will need to consider the elements of all three alternatives to determine which combination of improvements are most appropriate to address specific project needs.

For more details on the project description and location, see the Introduction chapter, as well as Attachment A, ***Existing Conditions Assessment Report.***

Reader's Guide

The PEL Study was conducted in accordance with the Federal Highway Administration (FHWA) and CDOT PEL guidance. Study recommendations are based on a series of technical steps and products based on PEL process principles. These documents are available in Attachments to this report, as follows:

- Attachment A, *Existing Conditions Assessment Report*
- Attachment B, *Alternatives Evaluation Technical Report*
- Attachment C, *Traffic and Safety Technical Report*
- Attachment D, *Agency and Public Coordination Summary*
- Attachment E, *FHWA PEL Questionnaire*
- Attachment F, *Project Cost Estimate Assumptions*

Purpose and Need

The purpose of the recommended transportation improvements in the I-25 Central corridor between approximately Santa Fe Drive/US 85 and 20th Street is to reduce congestion and improve safety and travel time reliability for the movement of people and goods. The improvements also consider access to and from I-25, as well as connectivity across I-25 for bicycles, pedestrians, transit, and local traffic.

*For more information on the Purpose and Need of this project, see the Purpose and Need chapter, as well as Attachment A, **Existing Conditions Assessment Report.***

Transportation improvements are required to address the project needs, described in Table 1, identified in the study area.

Table 1 Project Needs

Need	Description of Need
Improve Safety 	**Crashes**—With three crashes per day, 20 percent of which result in an injury or fatality, the corridor is at or above the 80th percentile for similar facilities in Colorado (CDOT, 2017b). **Structural Conditions**—At least three bridges have substandard clearance and are functionally obsolete, with vertical clearance as low as 12 feet, 5 inches, resulting in frequent bridge strikes. **Roadway Design Standards**—Substandard mainline and ramp geometry and roadway configurations increase the likelihood of crashes: • Ramp alignments are substandard at numerous locations. • Mainline I-25 and ramps have consistently deficient lane/shoulder width and stopping sight distance.
Reduce Congestion 	**Highway Capacity**—As of October 2017, I-25 carried more than 250,000 vehicles per day (vpd) (Project Team, 2017a) (350,000 people at a vehicle occupancy rate of 1.4), which greatly exceeds the 150,000 vpd capacity of a typical eight-lane freeway (Transportation Research Board [TRB], 2016). **Congestion**—The corridor experiences more than eight hours of congested traffic conditions on a typical weekday (INRIX, 2017). Delays are spread across three hours in the morning peak period and five hours in the evening peak period. **Traffic Growth**—Local and regional growth is expected to increase trip-making demand and traffic volumes on I-25 by at least 15 percent by 2040 (DRCOG, 2017). Substantial additional development in the corridor may increase travel demand beyond these expectations.
Improve Travel Time Reliability 	**Crash-Related Reliability**—The 1,000 crashes per year and additional breakdown-type incidents seriously impact travel reliability in the corridor. Each incident is estimated to cause four minutes of delay for every one minute in place. Beyond the regularly expected congestion, a major event—such as a sports game—or incident—such as a large crash requiring a full or partial freeway closure—occurs once every three to four days. **Incident Management**—Substandard shoulder widths and lack of refuge areas provide few locations for disabled vehicles and hinder emergency response activities. This often results in closure of mainline lanes during emergency-response activities. **Special Events**—The corridor does not have adequate infrastructure to accommodate traffic associated with the number of high-volume special events that routinely impact operations (such as events at Empower Field at Mile High Stadium, Pepsi Center, Coors Field, etc.).

Additional Considerations

As part of the project's purpose and need, two additional considerations were identified. These included optimizing access and improving cross connectivity, as described in Table 2.

Table 2 Additional Considerations

Additional Consideration	Description of Consideration
Optimize Access 	**I-25 Function**—As an Interstate, I-25's primary function is to serve regional travel while balancing and providing necessary access locally. The number and configuration of access locations in the I-25 Central corridor does not meet current design standards and results in I-25 not meeting its primary function as an interstate facility. **I-25 Weave Operations**—Multiple ramp locations do not meet minimum spacing criteria, creating short distances for vehicles to safely enter or exit mainline traffic. There are six deficient weave areas northbound and three southbound.
Improve Cross Connectivity 	**Network Fragmentation**—Barriers such as the South Platte River, I-25, and the railroads bisect the roadway network and result in vehicles making short trips on I-25. These short trips increase the merging and weaving on the freeway and contribute to congestion and safety issues. **Spacing of I-25 Crossings**—There are 15 crossings of I-25 along the corridor: • 12 of the 15 crossings are roadway crossings for vehicles. • 9 of the 12 roadway crossings include I-25 ramps. • 10 of the 15 crossings include pedestrian and bicycle facilities (many are substandard). • 1 crossing is a bicycle/pedestrian bridge at 16th Street.

Goals and Objectives

For more information on the goals and objectives of this study, see the Purpose and Need chapter, as well as Attachment A, ***Existing Conditions Assessment Report.***

In addition to the Purpose and Need of the project, a number of goals and objectives were identified to further assist in defining and evaluating the alternatives. These broader criteria provide a framework to address the corridor's setting, including adjacent environmental and land use considerations. These factors reflect themes and topics important to the study's stakeholders and the general public, as well as issues important to CDOT and other agencies. The goals and objectives include:

- **Environment**
  - Are there impacts or benefits to the natural environment?
  - Are there impacts or benefits to the social and built environment?
- **Future Flexibility and Technology**
  - Could the alternative accommodate future physical changes to the roadway (restriping, new lane assignments, new technology infrastructure, etc.)?
- **Planning Context**
  - How well does the alternative accommodate future land use changes?

Alternatives Development and Evaluation

The alternatives development and evaluation process for the I-25 Central PEL involved three levels of development and analysis that informed the creation of the alternatives. Level 1 focused on developing concepts to address the project's Purpose and Need and issues identified by stakeholders. Concepts carried forward to Level 2 then were evaluated on how well they addressed the project's goals and objectives. Following the Level 2 evaluation process, 13 concepts were recommended to be carried forward into future studies. These included:

- No Action
- Congestion Pricing
- Operations and Demand Management
- Bring the Corridor to Standard
- Add Collector/Distributor Roads
- Add Braided Ramps
- New Transit Facilities
- Add One General-Purpose Lane
- Realign and Split the Corridor
- Add Two General-Purpose Lanes
- Construct a Multi-Level Highway
- Realign Adjacent to Regional Transportation District (RTD)

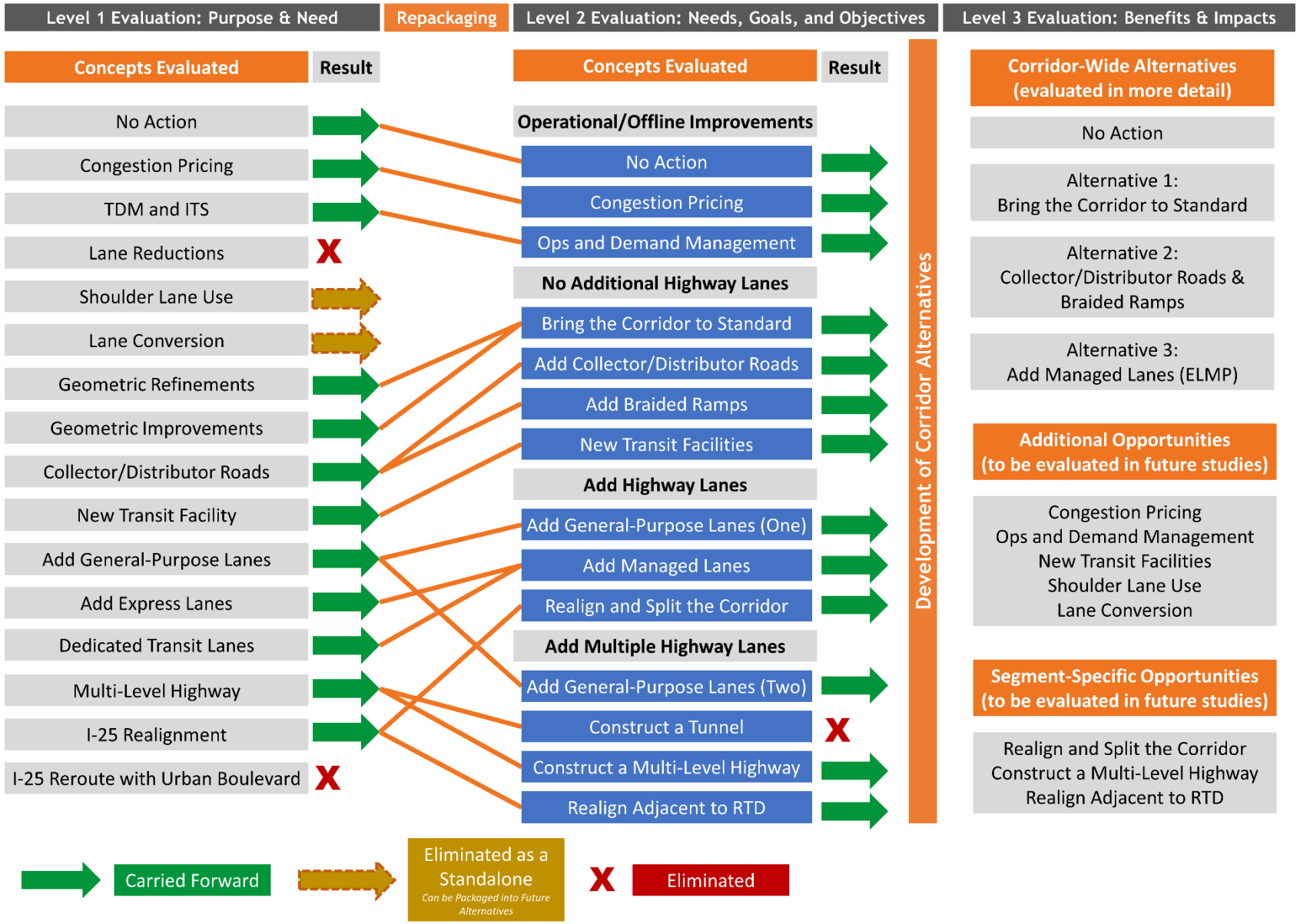
*A description of the methodology and summary of results for each of the three levels of evaluation and the outcomes of the evaluation process are included in the Development and Evaluation of Alternatives chapter, as well as Attachment B, **Alternatives Evaluation Technical Report**, and Attachment C, **Traffic and Safety Technical Report**.*

Although all of these concepts are recommended to be carried forward into future studies, there was a desire to further evaluate the concepts to better understand some of their specific benefits and impacts. Due to the high-level nature of the PEL Study, it was determined that evaluating each concept individually would not be appropriate at this time. Instead, concepts were packaged into four alternatives that were developed to represent a wide range of possible future conditions/options. These were called corridor alternatives and were evaluated in greater detail in the Level 3 evaluation. These included:

1. No Action Alternative
2. Bring the Corridor to Standard Alternative
3. Collector/Distributor Roads and Braided Ramps Alternative
4. Managed Lanes Alternative

Figure 2 shows the progression of alternative concepts from the Level 1 and Level 2 evaluations to the corridor alternatives evaluated in Level 3. Level 3 evaluation included significant analysis of traffic and safety using state-of-the-practice models, as well as a review of accesses and cross-connection opportunities. Level 3 evaluation concluded with recommendations for alternatives that merit further analysis. Additionally, this study considered the potential impacts of major potential land use changes in the area, estimated potential benefits of connected and autonomous vehicles (CAVs), and discussed how maximized transit ridership could reduce trips on I-25.

Figure 2 Alternative Concept Progression



Environmental Resource Considerations

Major environmental resources and constraints were reviewed throughout the alternative evaluation process, and it was decided early that concepts/alternatives would avoid major impacts to the most significant resource in the area, the South Platte River that largely parallels I-25. In general, the evaluation only included resources that would have different impacts among the alternatives and could be viewed in meaningful ways to help decision makers at this early planning level. Resources that would not differentiate the alternatives were not included in the analysis. Quantitative data were used where appropriate, and qualitative discussions among the project team added benefit to this process. As part of the Level 3 evaluation, environmental resources were reviewed for impacts to be evaluated in future detailed design and studies.

For more details on environmental resources, see the Environmental Resource Considerations chapter.

Public and Agency Involvement

This PEL Study started in the fall of 2017 and concluded in early 2020. A comprehensive program of public and agency involvement activities, tailored specifically for this study, was conducted. This study incorporates feedback received from various groups and communities engaged specifically through a series of technical meetings, focus groups, public meetings, and surveys. Comments and input received helped inform and frame the study's findings and recommendations. Initial engagement focused on the Purpose and Need and goals. Subsequently, the alternatives were evaluated at three progressively more-detailed levels of screening. Stakeholders provided comments and input at each of these successive evaluations.

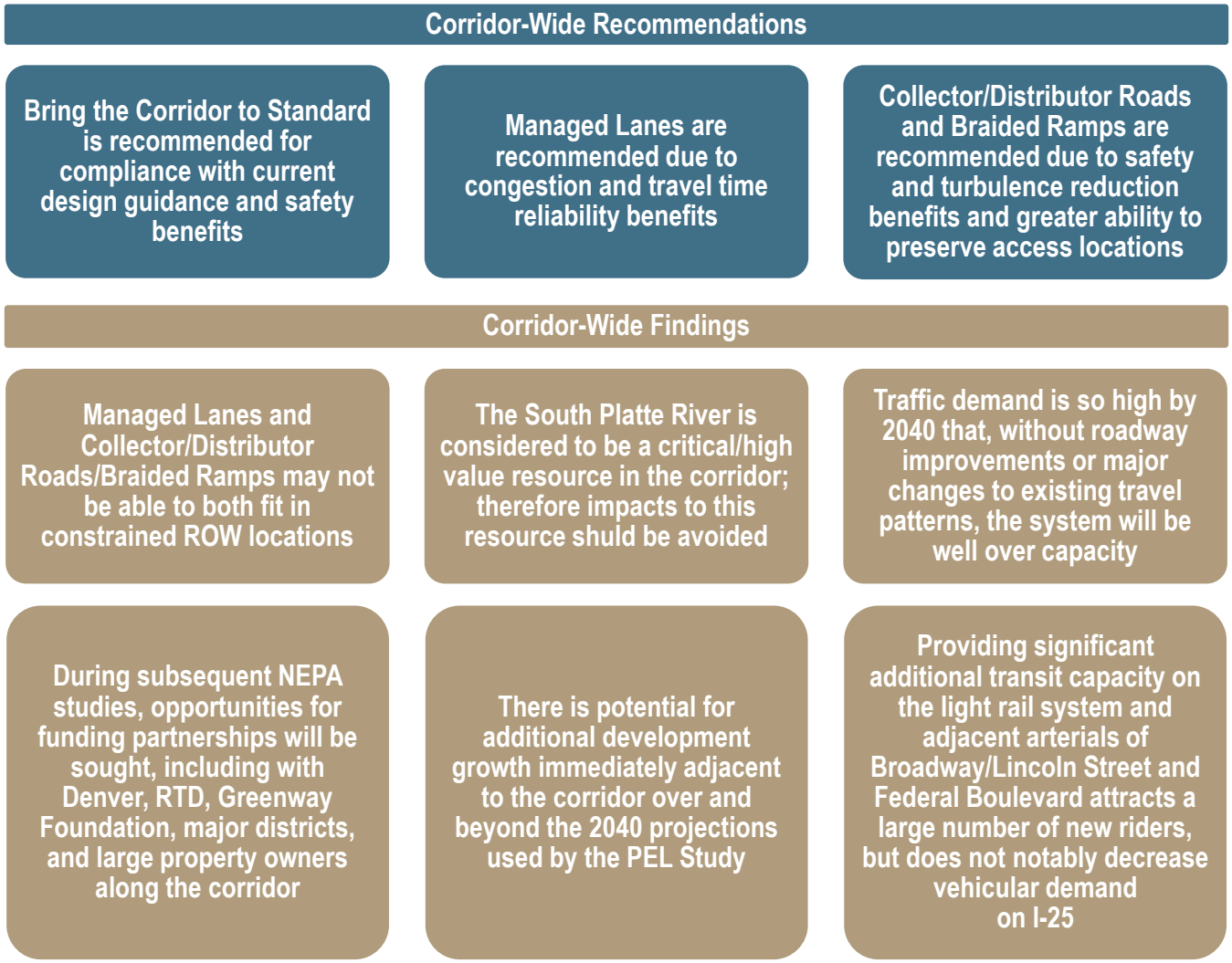
*For more information on public and agency outreach and involvement, see the Public and Agency Involvement chapter, as well as Attachment D, **Agency and Public Coordination Summary**.*

Action Plan

The Action Plan provides a detailed summary of projects that could be implemented individually or combined into larger packages of improvements. The Action Plan identifies the major benefits, impacts, and costs for each project. A summary of the corridor-wide recommendations and findings is shown in Figure 3. Analysis has shown that each of the Level 3 corridor-wide alternatives fulfill the project Purpose and Need in some way, and all three are recommended for further analysis in subsequent design to determine detailed benefits and impacts.

For more information on individual and Early Action projects, see the Action Plan chapter.

Figure 3 Corridor-Wide Recommendations and Findings



In addition to several smaller near-term fixes, the complexities associated with a large near-term need to replace the deficient bridges over I-25 at 23rd Avenue and Speer Boulevard are better understood. The next steps of analysis are likely to include:

- NEPA and design study focused on the Speer Boulevard and 23rd Avenue bridge replacements with alternatives that consider if managed lanes, collector/distributor roads, and/or braided ramps will be needed in between Colfax Avenue and 20th Street
- Level 2 traffic and revenue study to determine the potential of adding managed lanes to the entire project study area
- Express Lane Study (U.S. Highway 36 [US 36] to 20th Street) to determine the viability of converting the reversible lane to a bi-directional facility

Many of the individual projects and Early Action projects lend themselves to collaborative efforts. It is expected that CDOT will seek opportunities for partnerships with Denver, RTD, The Greenway Foundation, and the major districts and large property owners along the corridor.

How is this document organized?

This document is designed to provide readers with a complete record of the evaluation performed and the decision-making process that resulted in the development of the Action Plan and corridor-wide recommendations and findings.

This document includes six content chapters and six attachments that support the analysis and information presented. Each chapter includes multiple sections and subsections to make it easier for readers to find information.

The PEL Study Report includes the following chapters:

- Executive Summary
- Chapter 1—Introduction
- Chapter 2—Purpose and Need
- Chapter 3—Development and Evaluation of Alternatives
- Chapter 4—Environmental Resource Considerations
- Chapter 5—Public and Agency Involvement
- Chapter 6—Action Plan

Agency support and acknowledgements are included at the beginning of the study, while References are at the end of the study to source the data.

The attachments present technical data and detailed analysis supporting the results provided in this document. This document includes the following attachments:

- Attachment A—Existing Conditions Assessment Report
- Attachment B—Alternatives Evaluation Technical Report
- Attachment C—Traffic and Safety Technical Report
  - Appendix A—Detailed Ramp Volumes
  - Appendix B—Order-of-Magnitude Transit Ridership Development Process Technical Memorandum
  - Appendix C—Vissim Connected and Automated Vehicle Sensitivity Analysis Technical Memorandum
  - Appendix D—Land Use Sensitivity Analysis Technical Memorandum
  - Appendix E—Detailed Screenline Volumes
- Attachment D—Agency and Public Coordination Summary
  - Appendix A—Interview Summaries
  - Appendix B—Survey Summary
  - Appendix C—Comment Summary
- Attachment E—FHWA PEL Questionnaire
- Attachment F—Project Cost Estimate Assumptions

Chapter 1 Introduction

This chapter presents a brief description of the PEL process and the purpose of this study. It also summarizes the study area, including the surrounding neighborhoods, land uses, and transportation context. Lastly, this chapter includes a list of all the chapters in this document and associated technical reports, which are attached to this document.

The state of Colorado and the Denver metropolitan area are experiencing an economic boom. Riding the strongest national economy in decades, by all reports Denver is one of the fastest growing regions in the nation. Drawn by its attractive quality of life and job opportunities, people are moving to the Denver region at a rapid rate.

Outpacing the national growth rate, Metro Denver's population is projected to increase to more than 3.3 million by 2020.

While growth reflects Metropolitan Denver's economic vitality, sustaining it requires supporting the population's current and future demands. Critical to this sustainability is public infrastructure. Efficiently and effectively moving people and freight directly affects a region's vitality, now and into the future.

Perhaps no other part of Metropolitan Denver's transportation system is more essential than the I-25 corridor (see Figure 4). I-25 carries more people, vehicles, and freight than any other corridor in the Denver metropolitan area and Colorado. As the primary north-south corridor, I-25 connects commuters to jobs throughout the region; provides access to the Downtown Denver area; distributes products along the corridor; and, as part of the nationwide Interstate Highway System, serves long-distance travelers and freight carriers.

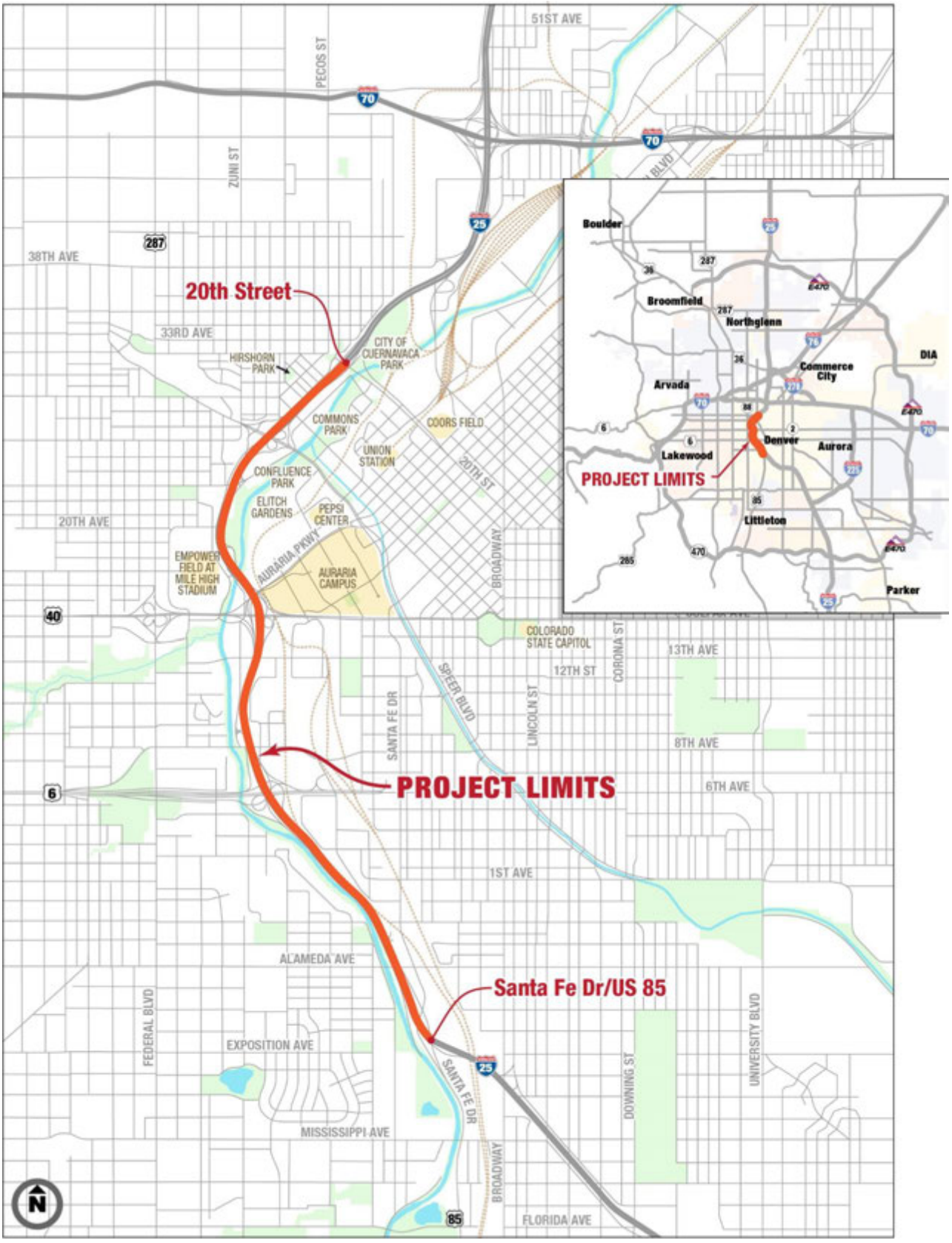
What is a PEL study?

A PEL study is a process typically used to identify transportation issues and environmental concerns in a large corridor, or in a specific location. It generally is conducted before any project construction funding is identified and before specific problems and solutions are known. At a high level, a PEL study:

- Reviews existing environmental resources and examines the existing infrastructure and congestion conditions
- Identifies corridor needs (i.e., safety, congestion)
- Defines and evaluates potential improvements
- Identifies possible impacts from proposed alternatives
- Develops a vision and implementation plan for priorities, both large and small

At completion, a PEL study should be able to link planning to environmental issues and result in useful information that can be carried forward into the NEPA process.

Figure 4 Study Limits



This report documents the analysis and recommendations this Study, which was needed for transportation improvements along a critical 4.5-mile section of the I-25 corridor within the heart of Downtown Denver. The study, called the I-25 Central PEL Study, which was developed through a collaborative process, provides a long-term vision for I-25 between Santa Fe Drive/US 85 and 20th Street. Conducted by CDOT in partnership with Denver, this vision will enable these sponsors to plan, build, and manage the corridor's future improvements and development, while addressing immediate maintenance needs. Combined with funding, it will enable the corridor to proactively respond to Denver's and Colorado's growth and sustain its critical role in supporting the region's economic vitality.

Where is the project located?

I-25 is a major north-south interstate highway extending from Interstate 10 (I-10) at Las Cruces, New Mexico, to Interstate 90 (I-90) in Buffalo, Wyoming (see Figure 5). At a national level, I-25 is designated as a Congressional High Priority Corridor within the National Highway System. Within Colorado, I-25 connects the Denver region to the National Highway System and cities and communities along the Front Range. As shown in Figure 4, I-25 also plays an important role within the Denver metropolitan region's transportation network, connecting regional communities north and south of Denver with Downtown and distributing goods and travelers throughout.

Two of the existing bridges within the study corridor, at 23rd Avenue and Speer Boulevard, are the lowest bridges anywhere along the length of I-25. This creates a barrier to over-height vehicles and results in diversion and out of direction travel for this regional highway.

The specific section of I-25 within Denver for this study is illustrated in Figure 4. As shown, it extends along an approximately 4.5-mile section of I-25 from the Santa Fe Drive/US 85 Interchange to the 20th Street Interchange, all within the limits of Denver. The I-25 Central corridor includes this section of I-25 and the immediately adjacent areas.

What is the purpose of a PEL study?

A PEL study is a planning-level process for making transportation improvement decisions within a corridor or specific location. It is not intended for construction use, but rather identifies, at a conceptual level, how different types of improvements—such as highway, transit, trail, or rail—can interact and be combined to solve transportation-related issues and challenges. It results in a long-term master plan of defined improvements from which specific projects can be identified and the various responsible agencies then can coordinate and advance collaboratively. The process links the decision making with the tenets of NEPA—the regulatory required procedures for the development of projects with a federal action. A PEL study streamlines subsequent steps for advancing the recommended projects.

A summary of the planning process used in the I-25 Central PEL that is intended to assist in the transition from planning to NEPA analysis is available in Attachment E, ***FHWA PEL Questionnaire.***

Before construction can begin, advancing the recommended projects would entail securing funding; performing additional study and coordination with affected agencies, stakeholders, and the public through NEPA; and developing design plans.

Figure 5 I-25's Interstate Connections

Why do a PEL study on I-25 Central?

The I-25 Central corridor is critical for moving people and goods to and from Downtown Denver while also providing access to other major transportation corridors within the larger highway network. It dually functions as a primary means of accessing the Downtown Denver area while also connecting communities along the Front Range and across the state. Originally built in 1958, expansion of the highway and continued development have resulted in tightly constrained right of way (ROW), with closely spaced local service and system interchanges.

The highway was originally built along the South Platte River, which is recognized as an important environmental and recreational asset that should remain in place while minimizing impacts. To the east, the corridor is constrained by the BNSF Railway-owned Consolidated Main Line (CML) tracks—the principal north-south freight rail line along the Front Range. In addition, large parcels of land along the corridor are in various stages of planning and redevelopment, creating additional constraints and further need for a well-connected and integrated transportation system. Combined, these conditions create a complex mix of challenges and opportunities for this corridor.

I-25 just south of US 6/6th Avenue. The highway is tightly constrained between the South Platte River and Trail (left) and the CML railroad tracks (right).

Enabling Critical Rehabilitation

Existing bridges at Speer Boulevard, 23rd Avenue, and the eastbound to northbound U.S. Highway 6 (US 6)/6th Avenue ramp have reached the end of their useful life. Each bridge provides a critical function in connecting adjacent communities and providing access to and from Downtown Denver and the transportation system. Several of these bridges have insufficient vertical clearance and have been struck by tall vehicles. Each bridge needs to be rehabilitated or replaced soon.

The PEL Study will enable CDOT to advance these critical needs in a timely manner. The correct placement and reconfiguration of these new structures, and associated ramps and intersections, can provide sufficient space for other future recommended improvements, enhancing the overall safety and traffic flow within the corridor now and into the future.

As one of the densest yet fastest-growing corridors in the Denver metropolitan area's transportation network, recommendations for I-25 need to integrate and optimize a system of improvements within tight confinements while providing the intended functionality of the corridor. Meeting the needs requires a wide range of improvement types. Improvements also need to balance maintaining and providing efficient service with the adjacent land uses, planned developments, and goals of the potentially affected interests.

With limited funding currently available, yet existing pressures to rehabilitate elements of the existing I-25 infrastructure, the PEL study process is ideal for the I-25 Central corridor. The PEL process provides the necessary comprehensive framework to address the complexities of the corridor with the necessary flexibility for CDOT and others to implement its recommendations as funding and priorities allow.

This I-25 Central PEL will serve as a vision for the 4.5-mile corridor, prompting improvements as funding becomes available, likely over the next 10 or 20 years.

Additional benefits of the PEL study process include:

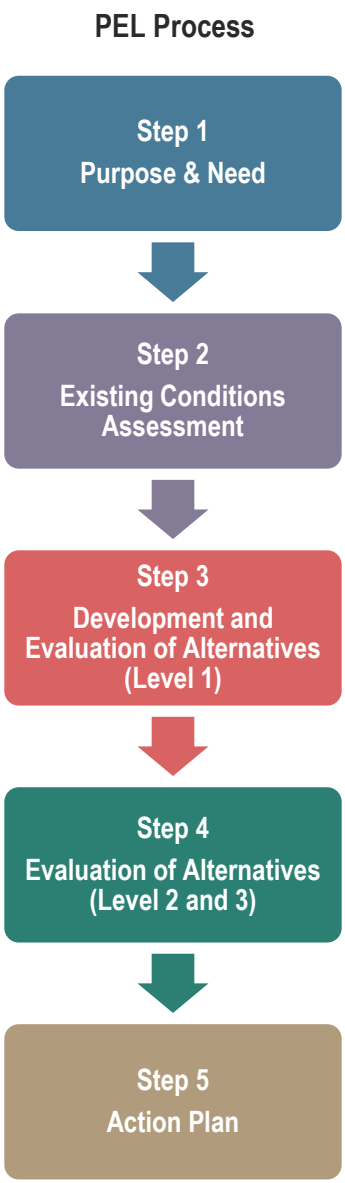
- Recommends a long-term master plan of system improvements, including the general concept and scope of individual yet integrated projects, enabling the corridor to grow and be managed long term in a compatible and reliable manner
- Identifies the key issues, challenges, and root causes of the need for transportation improvements
- Assesses the natural and manmade setting to balance the impacts of the improvements with the preservation of the corridor's environmental, community, and land development goals
- Engages agencies, stakeholders, the public, and other interested parties in the decision-making process
- Defines an action plan that identifies project priorities, agency responsibilities, next steps, and conditions which would trigger the further development of projects for timely construction

Several key questions and issues specific to the I-25 Central corridor are addressed by the PEL study. As seen in Figure 6, the PEL process answers these questions through a stepped, sequenced, and collaborative method, culminating in the recommended improvements and action plan.

A thoughtful and organized approach to the study process comprehensively addressed this mix of potential solutions. Toward this end, the study used the following approaches:

- Defined limits that directly influence travel within the corridor and where improvements are within the reasonable scope of the study
- Focused the study Purpose and Need for direct and achievable safety and operational performance objectives on I-25 within the corridor
- Included broader improvement evaluation factors relating to community, connectivity, and land development goals
- Maximized all currently and potentially available capacities of complementary facilities and alternative modes that could reduce the scope of needed direct improvements on I-25
- Developed alternatives that combine, in varying degrees, the best elements of the initial standalone improvement concepts based on the ability to meet the identified needs

Figure 6 PEL Process



Study Questions

What are the study's goals?
- Limits of the study along I-25?
- Purpose of improving the I-25 corridor?
- How to measure the improvements of the system?
- Additional goals for integrating all interests?

What are the issues to be addressed?
- Traffic patterns and volumes for Downtown and through-traffic?
- Safety and congestion along I-25?
- Condition of existing I-25 pavement and bridges?
- Environmental setting adjacent to and around I-25?
- Planned developments adjacent to I-25?

Do the concepts developed solve the problems?
- Maximizing existing system before expanding I-25?
- Expansion, reconfiguration, or realignment of I-25?
- If new lanes, what kind of lanes?
- Operational features to improve safety and traffic flow?
- Other travel corridors in lieu of I-25?

Can the concepts be combined into a system of improvements (alternatives)?
- Elements of concepts that address needs?
- What combined concepts best improve the system?
- Are the impacts and trade-offs acceptable?
- Flexible with potential future vehicle technologies?
- Recommendations for more study and development?

How should the system improvements be implemented?
- Specific projects within the overall system recommendations?
- Responsibilities for CDOT, Denver, or others?
- Next steps for the projects?
- Priorities for near-term and long-term projects?

Why is the planning context important?

Previous and ongoing studies, planning efforts, and land development plans within or adjacent to the corridor help set the stage for this study and frame its planning context. These other studies relate to some localized element or area of the existing infrastructure and land use setting, helping define the corridor's anticipated future conditions. Their identified goals, issues, and needs help confirm the needs analysis for this study and were appropriately incorporated into the PEL Study's analyses. Recommendations and planned improvements from these previous efforts have been integrated and/or coordinated for a comprehensive set of recommendations. Furthermore, to the extent the existing I-25 infrastructure creates a barrier or constraint affecting the previous recommendations, the previously planned improvements were re-envisioned and addressed with this study's findings, as appropriate.

Previous or ongoing planning efforts that influenced this study and were incorporated into the analyses and recommendations include efforts by CDOT, Denver, and others. These past studies provide specific localized recommendations for a wide variety of improvements relating to this study, including bridge replacements, safety and traffic operational improvements, ramp realignments or closures, interchange reconfigurations, highway widening, new crossings, enhancements to local corridors, and other pedestrian and multimodal enhancements to better connect neighborhoods and communities. Ongoing planned private developments within the corridor were included in the study's land use projections for the travel demand and traffic analyses and were considered in the development of the improvement recommendations for traffic access and connectivity.

A list and description of previous planning efforts that form the planning context are available in Attachment A, ***Existing Conditions Assessment Report.***

Project Surroundings

Elitch Gardens as seen from the 23rd Avenue interchange

Zuni Street near the 8th Avenue interchange looking north

Lower Downtown skyline as seen from westbound Speer Boulevard

Southbound I-25 near Empower Field at Mile High

Northbound I-25 near 23rd Avenue

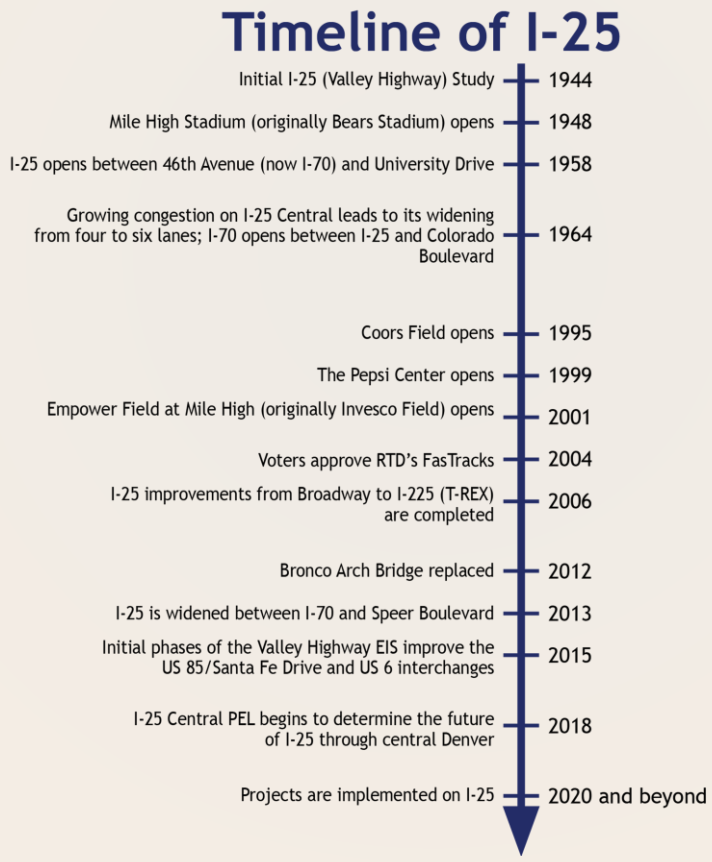
What is the existing transportation system?

More detailed descriptions of the existing and planned transportation system within the corridor are provided in Attachment A, ***Existing Conditions Assessment Report.***

The existing transportation system within the corridor consists of the I-25 roadway, bridges, and interchanges; rail facilities; bicycle/pedestrian facilities; and transit. This system encompasses more than I-25; it is a multimodal system serving different and varying uses. Understanding how the existing facilities function and interact is important to developing an improved and interconnected system along the corridor while ensuring the preservation of existing services. The following section generally describes the existing multimodal transportation system.

The Existing Transportation System is a Reflection of its History

Today's transportation system within the corridor is a product of its history. Built over many years, starting with initial planning in 1944, today's I-25 system includes more recent improvements, such as FasTracks and the reconfiguration of the Santa Fe Drive/US 85 Interchange, overlaid upon legacy elements of former projects and outdated designs. Furthermore, since its original construction, as Denver has grown and developed, most of the remaining undeveloped land around the corridor has been built up, further constraining an already narrow corridor. The corridor, originally conceived as a highway route, is now a multimodal system of facilities with a mix of more modern and older, antiquated designs (CDOT, 2017a).



Roadway System

The existing roadway system within the corridor is comprised of the mainline I-25 roadway and multiple interchanges. Built and expanded over a number of years, the pavement widths and configuration are highly variable due to the tight constraints of the ROW. As shown in Table 3, I-25 has a prevailing cross section through the corridor of four through and continuous general-purpose lanes. Some sections contain one or more auxiliary lanes. Due to the surrounding constraints, both the inside and outside shoulders are variable in width, with some sections having localized areas with only 2-foot-wide shoulders. The section between US 6/6th Avenue and Alameda Avenue has 11-foot-wide lanes. Throughout the corridor, the posted speed limit is 55 miles per hour (mph).

Table 3 Description of I-25 Typical Section within the Corridor

Location (from-to)	Number of Lanes				Notes
	Northbound		Southbound		
	GP	Aux	GP	Aux	
20th St. to Speer Blvd.	4	1	4	2	Retaining wall adjacent to southbound I-25
Speer Blvd. to 23rd Ave.	4	1	4	0	
23rd Ave. to 17th Ave.	4	1	4	0	Two-lane frontage road adjacent to southbound I-25
17th Ave. to Colfax Ave./Auraria Pkwy	4	1	4	1	
Colfax Ave./Auraria Pkwy to 8th Ave.	4	2	4	2	2-foot inside shoulder northbound I-25
8th Ave. to US 6/6th Ave.	4	1	4	2	2-foot inside shoulder northbound I-25
US 6/6th Ave. to Alameda Ave.	4	1	4	1	11-foot lanes and four-foot inside shoulder northbound and southbound
Alameda Ave. to Santa Fe Dr./US 85	4	0	4	1	

GP = General purpose lanes, Aux = Auxiliary lanes

Existing features within the corridor include system interchanges, which connect I-25 to the region's highway network; local interchanges, which provide access to the Downtown area local street network; and overpass or underpass crossings. Due to the tight spacing of the interchanges and the constrained ROW, many of the existing interchange configurations are unconventional and atypical.

Figure 7 shows the locations of the existing I-25 interchanges and crossings. Each feature description includes the general configuration and whether it crosses over or under I-25. These features are described by number next to the figure.

Figure 7 Interchanges and Crossings

System Interchanges

1. Colfax Avenue/Auraria Parkway Interchange—Partial cloverleaf with directional ramps configuration with overpass
2. US 6/6th Avenue Interchange—Directional ramps configuration with overpass
3. Santa Fe Drive/US 85 Interchange—Single-point urban interchange with directional ramps configuration with underpass

Local Interchanges

4. 20th Street Interchange—Traditional diamond configuration with overpass
5. Speer Boulevard Interchange—Partial cloverleaf configuration with overpass
6. 23rd Avenue Interchange—Traditional diamond configuration with overpass
7. 17th Avenue/South Platte River Interchange—Offset diamond configuration with underpass
8. 8th Avenue Interchange—Offset diamond configuration with underpass
9. Alameda Avenue Interchange—Half diamond configuration with overpass

Non-Interchange Crossings

10. Highland Pedestrian Bridge (16th Street) Overpass
11. 15th Street Overpass
12. Walnut Street Underpass
13. RTD W Line Underpass
14. 13th Avenue Underpass
15. BNSF Railway Underpass

Heavy Rail System

The BNSF Railway, Union Pacific Railroad (UPRR), and RTD operate and maintain heavy rail facilities within and along the corridor. The locations of these facilities are shown in Figure 8. RTD's heavy rail commuter rail facilities are north of the project limits. East of I-25, two mainline heavy freight rail tracks parallel I-25 the entire length of the corridor. These tracks are under a Joint Facility Agreement between UPRR and BNSF Railway and operate as the CML. Currently, BNSF Railway operates 24 trains per day, on average, on these tracks (BNSF Railway, 2017). UPRR also operates on these tracks; its average train traffic is unknown currently. BNSF Railway transports a wide variety of commodities at an operating speed between 20 mph and 30 mph. These tracks are adjacent to multiple industrial sites and provide rail access/deliveries to many of them. Note that the Valley Highway Environmental Impact Statement (EIS), published by CDOT in 2006, identified a Preferred Alternative that moved the existing BNSF Railway alignment between approximately US 6/6th Avenue and Alameda Avenue to the east, farther away from the highway (CDOT, 2006). This portion of the Preferred Alternative has not yet been funded.

Bicycle and Pedestrian Facilities

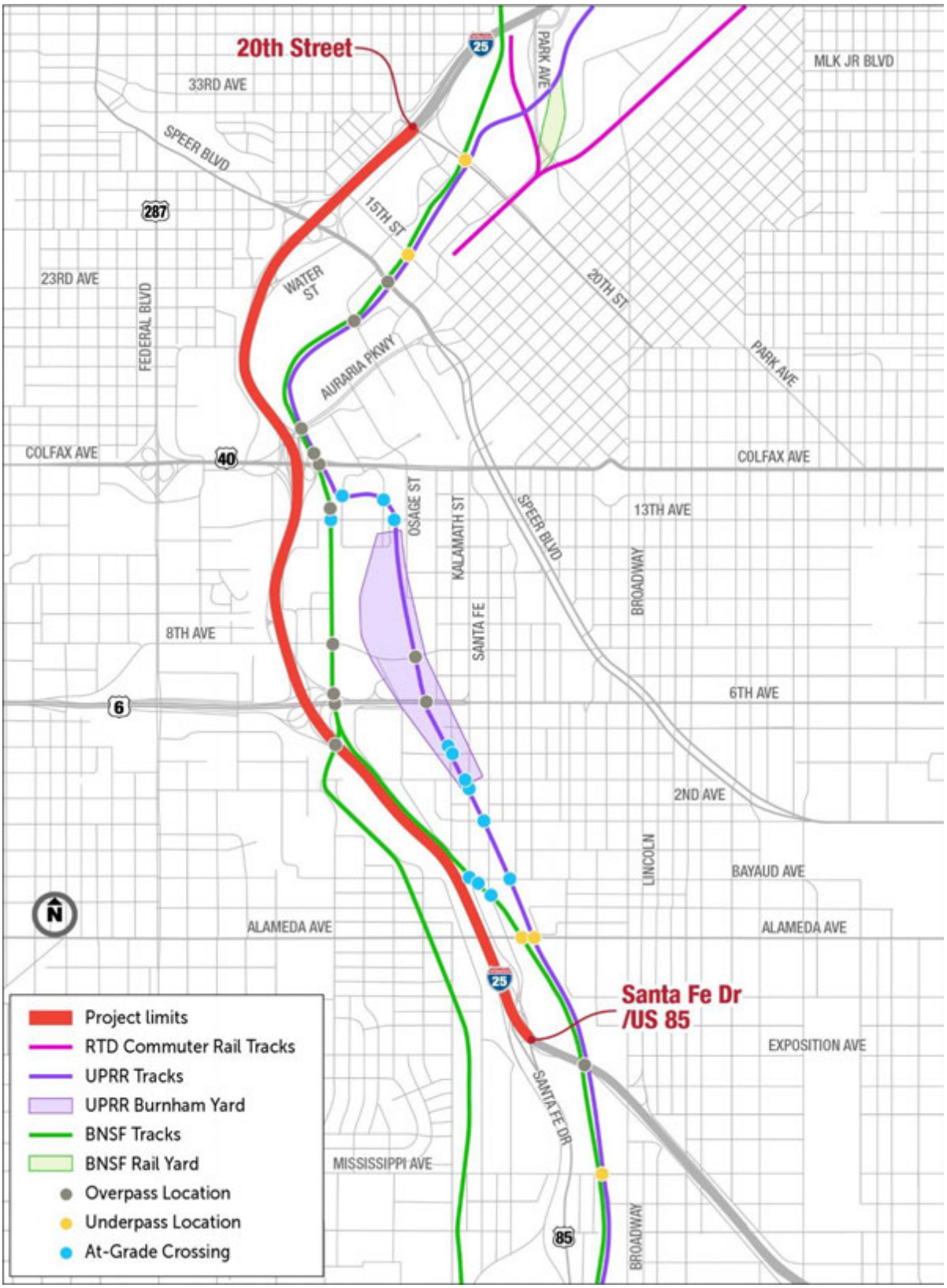
Although walking and bicycling is not permitted on I-25—which is the facility of primary focus for this study—it does interact with and affect bicyclists and pedestrians within the corridor. As shown on Figure 9 and Figure 10, the primary bicycle and pedestrian facilities along the corridor include the South Platte River Trail, which parallels I-25, and multiple bridges and underpasses across I-25 that accommodate bicyclists and pedestrians. Of the multiple I-25 crossings, two are pedestrian-only overpass bridges—16th Street and Speer Boulevard. All others are associated with a roadway crossing as an attached sidewalk. Bicycle accommodations within the corridor exist as a mix of bicycle lanes, signed routes/shared lanes, multi-use paths, and off-street trails. It is readily apparent that barriers to bicycle and pedestrian mobility—including I-25, the railroad tracks, and the South Platte River—are formidable. Additional east-west connections across I-25 and other barriers, as well as improvements to existing crossings, especially where bicyclists and pedestrians must cross freeway ramps, are needed.

Transit System

Transit offers an alternative to vehicle travel and represents a key alternate mode choice for users traveling through the corridor. Although limited transit services currently travel on I-25 within the corridor, existing transit services cross and run alongside I-25. Transit service within the corridor is provided primarily by RTD, including light rail and bus services. Other transit services and providers include Bustang, operated by CDOT; interstate bus and train service provided by Greyhound and Amtrak; and other private transit providers serving the Denver metropolitan area. Additionally, future transit service in the area may be provided by the Denver Department of Transportation and Infrastructure (formerly Denver Department of Public Works). As shown on Figure 11, there are several fixed-route bus services currently operating within and near the corridor consisting of local and regional services.

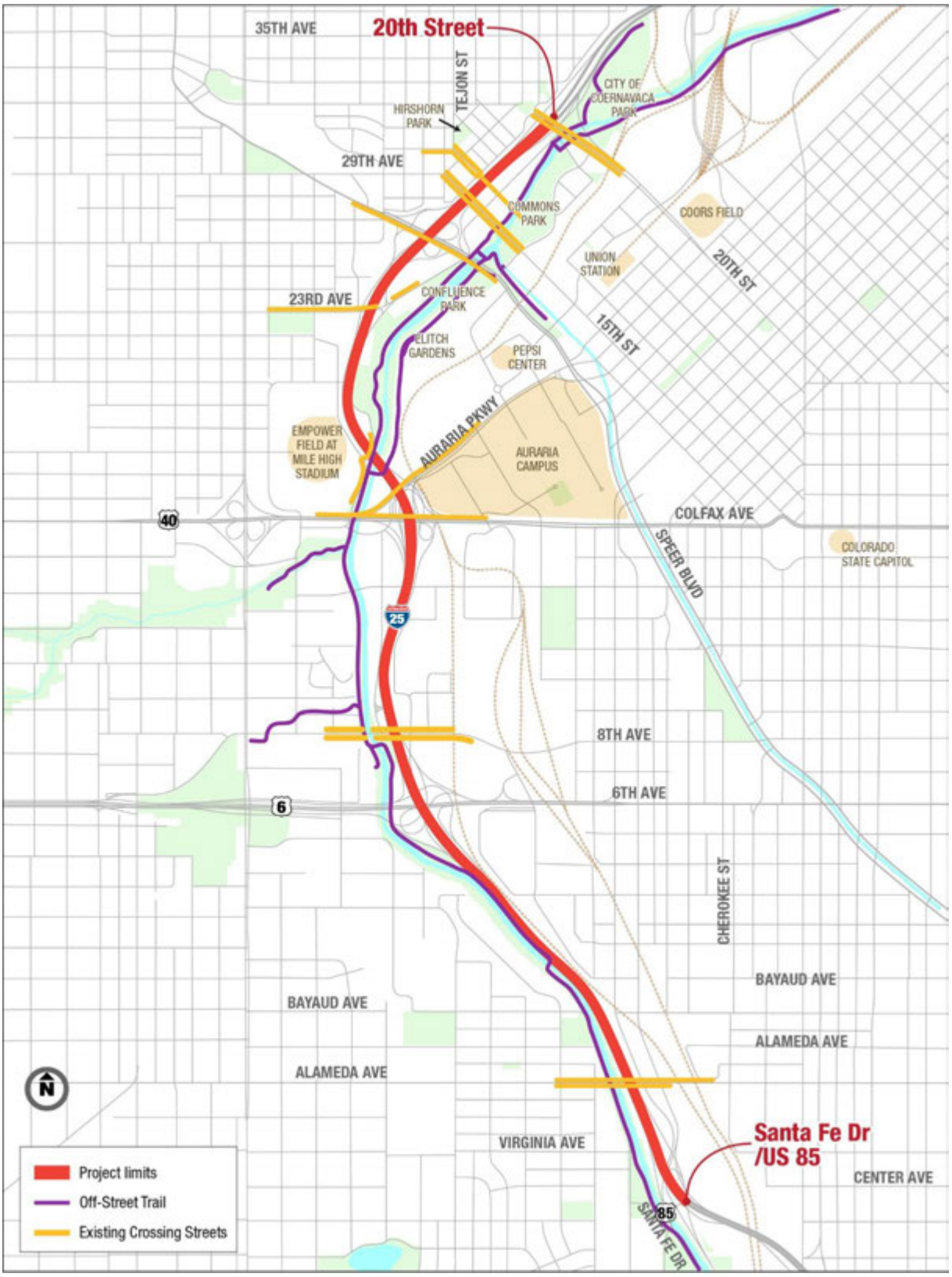
In addition to bus service, several light rail routes that serve the Denver Area are adjacent to and cross I-25 within the corridor. Passenger light rail service in this corridor is provided by RTD on six lines (C Line, D Line, E Line, F Line, H Line, and W Line) with nine light rail stations near the corridor. These light rail lines are shown on Figure 11.

Figure 8 Heavy Rail Facilities



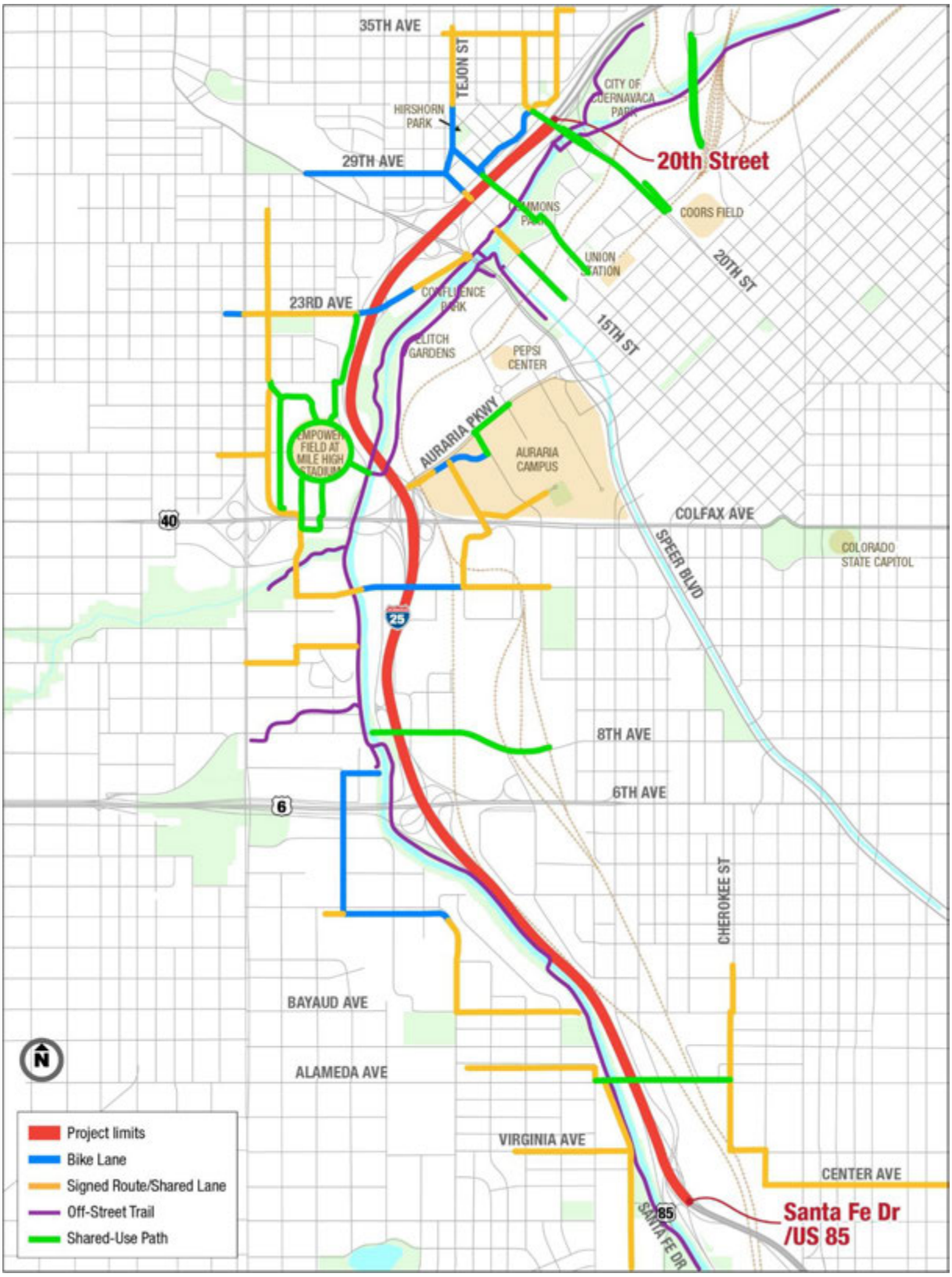
Source: Denver, 2018

Figure 9 Pedestrian Facilities



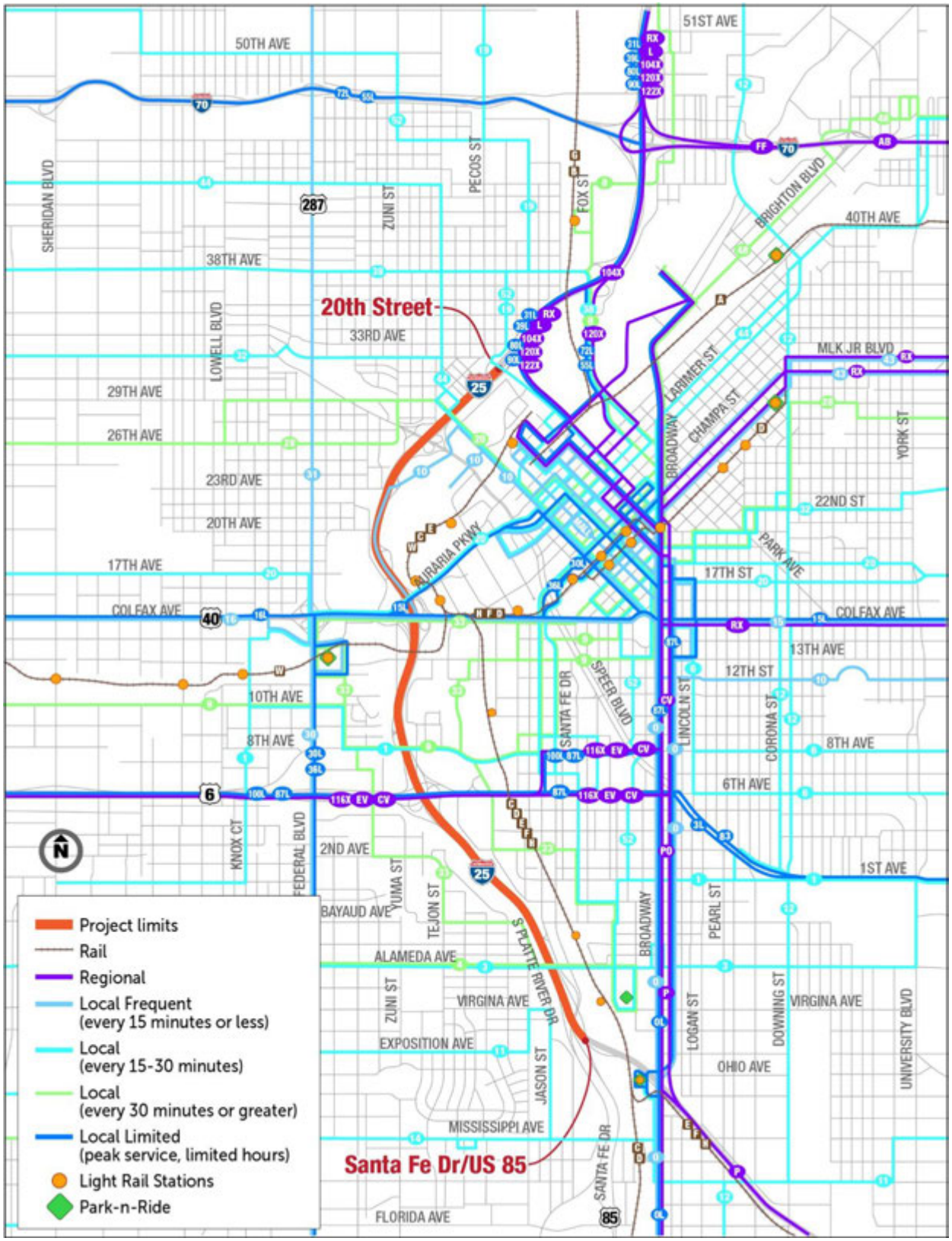
Source: Denver, 2017b

Figure 10 Bicycle Facilities



Source: Denver, 2017b

Figure 11 Existing RTD Transit Services Within the Study Area



Source: RTD, 2017a; RTD, 2017b; RTD, 2017c; RTD, 2017d; RTD, 2017e

Why is understanding corridor travel patterns important?

Built over the past few decades, the existing transportation system within Denver and within the corridor generally is a direct reflection of where people want to travel to and where they come from. Over time, as the system has been built, the region has grown and developed in correlation. While many factors affect this interdependent relationship, these regional travel patterns (where travelers come from and go to) have a direct impact on the amount of travel within the corridor. Understanding the region's and, by connection, the corridor's travel patterns is essential to knowing the root causes of the operational problems and improvement opportunities within the corridor.

As a critical link in the Denver metropolitan area's transportation system, travel within the corridor also is influenced directly by its connections to and the available capacities of the regional highway network and transit systems. To the extent they are available, encouraging travelers to choose travel options other than single-occupancy vehicles—such as transit, bicycling, walking, or carpooling—reduces the number of vehicles on I-25, maximizing the shift to other modes of travel.

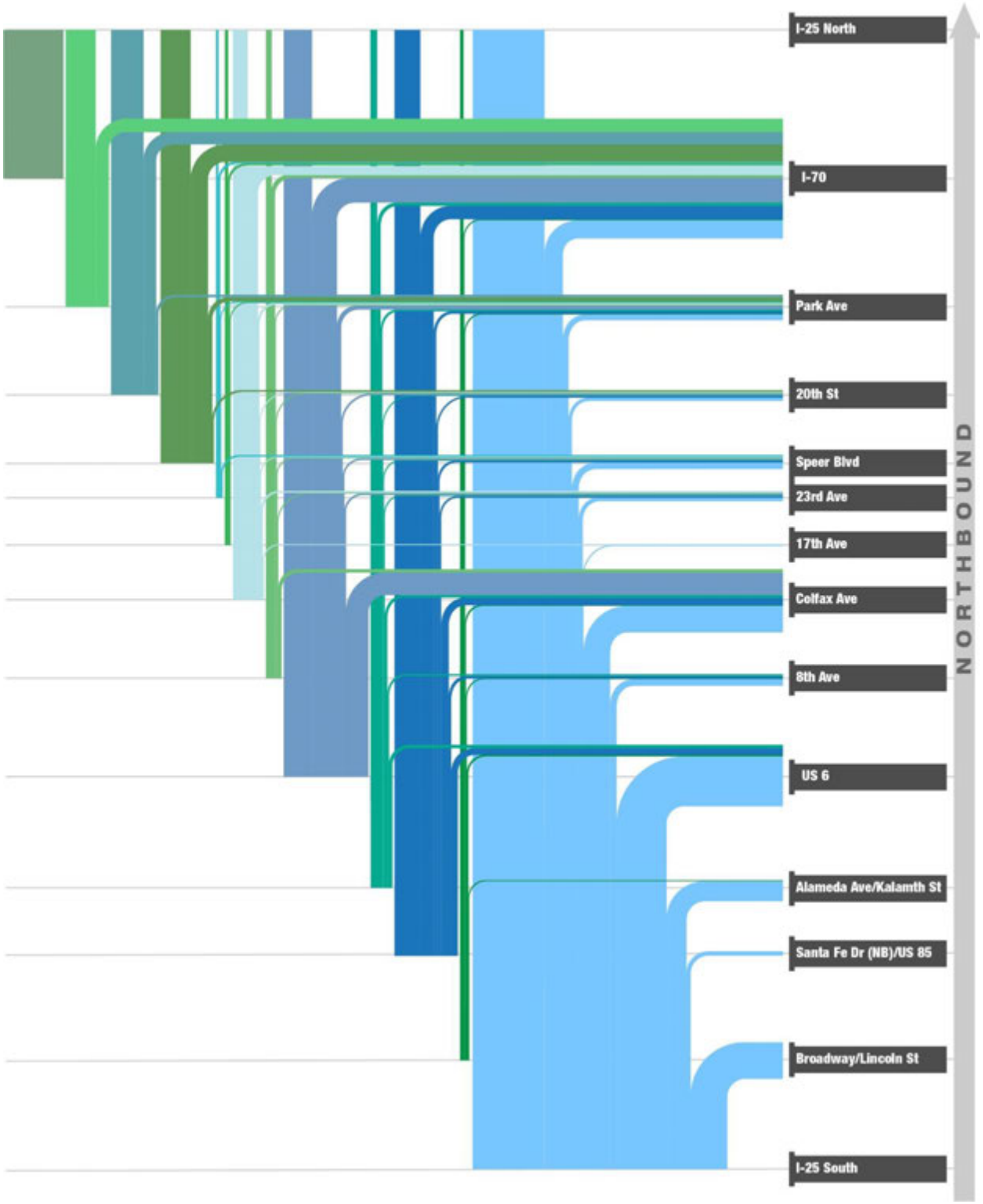
For the purposes of this analysis, two types of travel patterns generally exist within the I-25 Central corridor: regional and local. Regional travel passes through the corridor, destined and originating from somewhere other than Downtown Denver. Local travel is going to or coming from Downtown Denver. As shown in Figure 12, approximately 50 percent of northbound traffic entering the corridor is regional travel, either passing through along I-25 or exiting at US 6/6th Avenue. Similarly, as shown in Figure 13 for the southbound direction, approximately 60 percent of traffic entering the corridor from north of Interstate 70 (I-70) is regional travel. For both directions, the remaining traffic is Downtown-oriented local travel.

Today's traffic-related operational problems along I-25, such as crashes and congestion, are partially a result of this travel pattern mix. Understanding where traffic wants to travel helps diagnose the operational challenges and identify how improvements can address these core issues.

I-25 Central Corridor Traffic Facts

- Current traffic volumes: 178,000 vpd to 260,000 vpd
- Trucks account for 4 percent to 6 percent of traffic
- Roughly half the traffic is regional
- Roughly half the traffic is Downtown-oriented
- Northbound:
  - Westbound US 6/6th Avenue is the highest volume off-ramp
  - Eastbound US 6/6th Avenue is the highest volume on-ramp
- Southbound:
  - Santa Fe Drive/US 85 is the highest volume off-ramp
  - Eastbound US 6/6th Avenue is the highest volume on-ramp

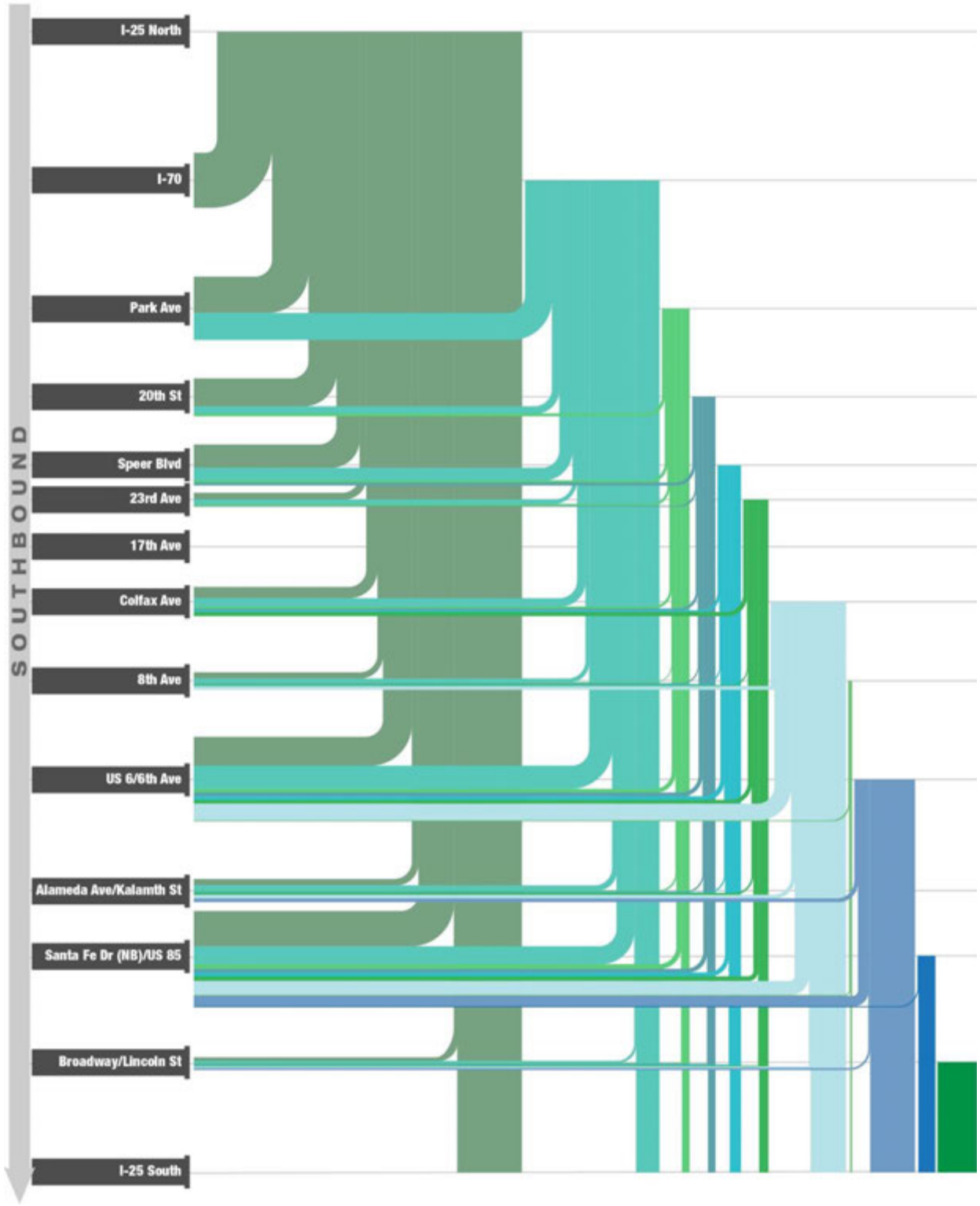
Figure 12 I-25 Central Northbound Vehicle Travel Patterns



The width of the lines in this figure are scaled based on total daily traffic volumes. The vertical portion of each line represents traffic coming onto I-25 from an interchange. The horizontal portion of the line represents the portion of traffic exiting to each interchange.

Source: StreetLight Data, Inc., 2017

Figure 13 I-25 Central Southbound Vehicle Travel Patterns



The width of the lines in this figure are scaled based on total daily traffic volumes. The vertical portion of each line represents traffic coming onto I-25 from an interchange. The horizontal portion of the line represents the portion of traffic exiting to each interchange.

Source: StreetLight Data, Inc., 2017

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Chapter 2 Purpose and Need

The I-25 Central PEL Study was initiated to identify and assess potential transportation improvements along and within the corridor. An important and foundational first step in the study process is to answer the core question, "What are the study's goals?" The Purpose and Need answers this question.

Through an analysis of the infrastructure's ability to effectively serve the existing and projected movement of people and goods, the Purpose and Need defines the direct transportation-related needs within the corridor. This analysis identifies the core issues to be addressed, defines the extent of the deficiencies, and establishes how the benefits of the potential improvements are measured. The Purpose and Need provides the framework for the evaluation of the alternative improvements, leading to the study's recommendations. It is a statement that guides the study's decisions and provides the first set of criteria in the alternatives evaluation process.

*The **Existing Conditions Assessment Report**, included as Attachment A, provides the technical analyses and assessment of the planning context that form the study's Purpose and Need.*

The Purpose and Need also reflects the broader goals of the communities surrounding the corridor. Whether people will be affected by the potential improvements or have interests that interact with the corridor, the framework incorporates secondary goals important to the local communities and neighborhoods. Developed in consultation with key stakeholders through one-on-one interviews, focus groups, and website comments, these goals provide additional evaluation considerations. The goals provide guidance for assessing the relative benefits of the alternative improvements and identify opportunities for local improvement features to be coordinated and jointly developed with local partners. Combined, the study's needs and goals ensure the recommendations comprehensively address both the fundamental transportation-related issues and the broader opportunities within the corridor's setting.

What is the purpose of the improvements?

The purpose of the recommended transportation improvements in the I-25 Central corridor between approximately Santa Fe Drive/US 85 and 20th Street is to reduce congestion and improve safety and travel time reliability for the movement of people and goods. The improvements also consider access to and from I-25, as well as connectivity across I-25 for bicycles, pedestrians, transit, and local traffic.

Why are the improvements needed?

Transportation improvements are required to address three identified needs along the corridor. These include the need to improve safety, reduce congestion, and improve travel time reliability. The following sections describe each of these needs.

Improve Safety

Having the ability to utilize a transportation network without incurring injury or property damage is fundamental to any transportation system, including I-25. However, in its current condition, I-25 Central is not fully satisfying this need. This determination was based on an analysis of existing crashes, structural conditions, and current roadway design/configuration.

Crashes

Crash data were collected and analyzed for a three-year period between 2013 and 2015. These data revealed that the mainline freeway and ramps experience more crashes than would be expected compared to other similar facilities. This indicates that opportunities exist to improve safety within the corridor.

Historical crashes also were mapped to identify concentration areas, or "hotspots." Figure 14 shows the high-density crash locations for all crashes. As indicated, the interchange areas have the highest crash densities. The density analysis of fatal and injury crashes revealed similar results, with hotspots being located near and around the interchange areas.

Safety Analysis Findings (2013 to 2015)

- Total of 3,024 crashes—more than 1,000 crashes per year:
  - 7 Fatal (0.2%)
  - 604 Injury (20%)
  - 2,423 Property Damage Only (80%)
- Most Common Crash Types:
  - Rear-end 61%
  - Sideswipe 24%
- Crash Locations:
  - Mainline 80%
  - Ramps 14%
  - Ramp Terminals 6%

Source: CDOT, 2017b (Only crash data for 2013-2015 were available when existing conditions were prepared for this area in 2017)

The safety analysis findings are not unexpected, given the high number of vehicles exiting and entering I-25 and the tightly spaced interchange locations. Under these conditions, interchange areas tend to be prone to higher crash rates because drivers are most likely to weave, merge, or diverge in these areas, increasing the likelihood of a crash.

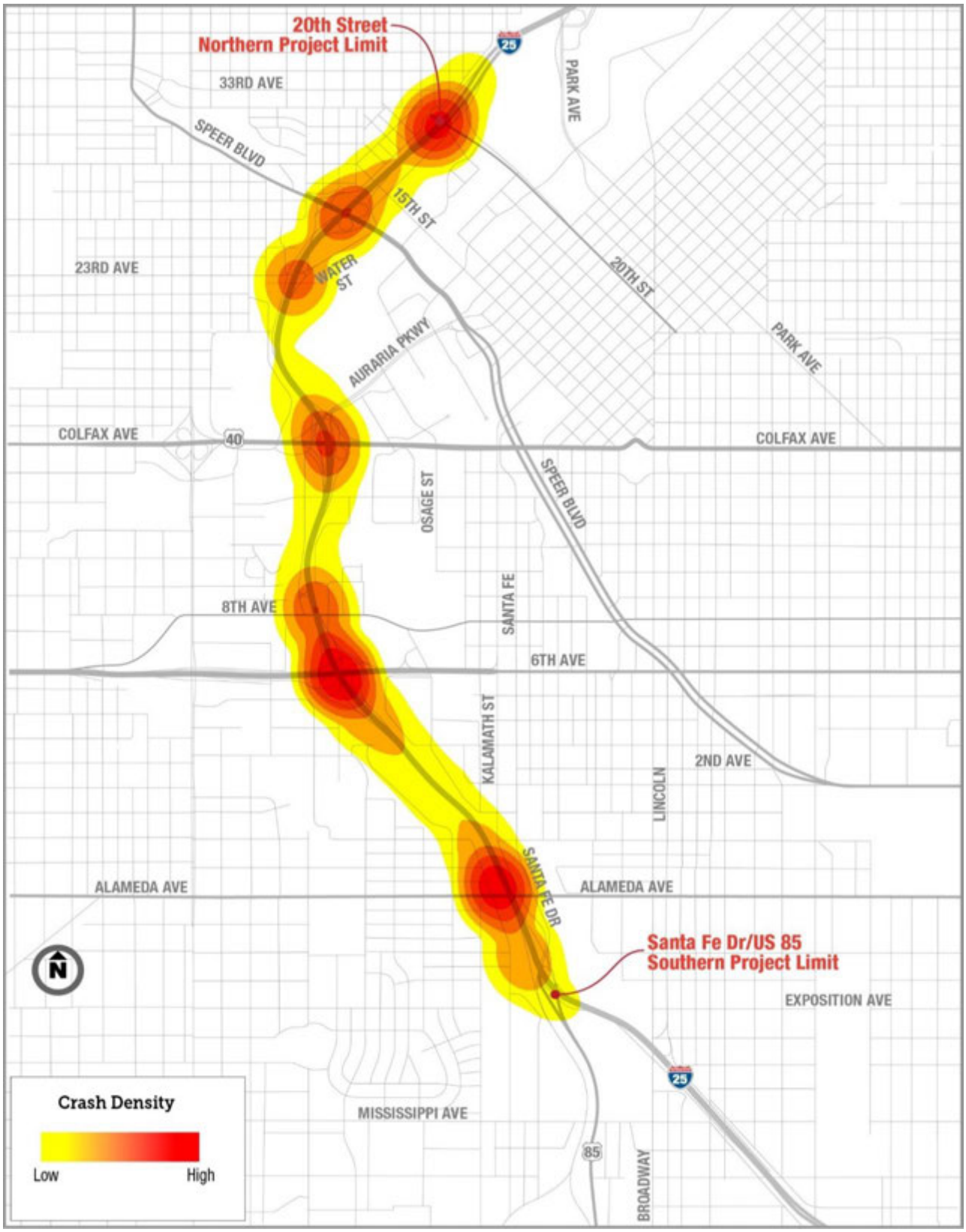
Structural Conditions

Although many factors contribute to crashes, some specific conditions within the I-25 Central corridor are key contributors to safety concerns. One of these is the low/substandard vertical clearances at the existing 23rd Avenue and Speer Boulevard bridge overpasses. The low clearances between I-25 and the bottom of these structures results in tall vehicles—such as trucks—sometimes hitting these structures. This condition creates both an immediate safety concern for those vehicles directly involved in these kinds of crashes, as well as a longer-term safety concern for the bridge structures themselves, which have been damaged by these crashes.

Roadway Design Standards

Another factor affecting safety is the design of the roadway itself. The existing alignment and roadway cross section of I-25 lacks modern engineering design elements that contribute to safety. Adequate vertical clearances under bridges, wide enough shoulders for disabled vehicles and emergency responders to move/work out of the active travel way, and smooth enough curves to meet driver needs and expectations are important design elements for roadway safety.

Figure 14 Crash Density Within the Corridor



Source: CDOT, 2017b

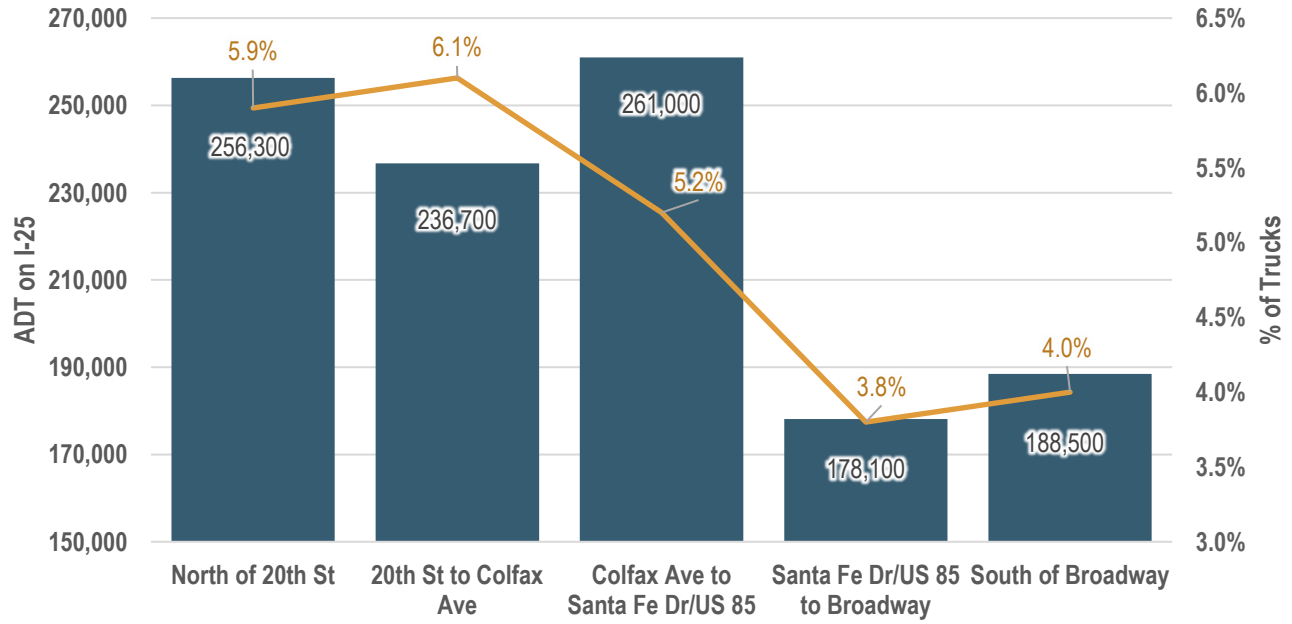
Reduce Congestion

Congestion on I-25 is a barrier to the movement of people and goods. This congestion negatively impacts the economy, the environment, and the region's quality of life. The identified need to reduce congestion was based on three criteria, including the capacity of the highway, the existing magnitude of congestion, and forecasted traffic growth.

Highway Capacity

Traffic count data show that the average daily traffic (ADT) on I-25 Central ranges between 178,000 vehicles per day (vpd) and 261,000 vpd, depending on the location (Project Team, 2017a). Generally, current traffic volumes exceed the average capacity of I-25 Central—considered to be an eight-lane freeway facility—which is estimated to be approximately 150,000 vpd (TRB, 2016). As shown in Figure 15, daily traffic is greater in the northern portion of the corridor, north of Colfax Avenue, than it is in the southern portion. A similar pattern can be seen in the truck data, ranging between 4 percent and 6 percent, which shows a higher percentage of trucks north of Colfax Avenue.

Figure 15 I-25 ADT and Truck Percentage by Location



Source: Project Team, 2017b

Congestion

In 2017, I-25 experienced an average of eight hours of congestion during most weekdays. This congestion happens during the morning and evening commuting periods, which generally occur between 6:30 a.m. and 9:00 a.m. in the morning and 2:30 p.m. and 8:00 p.m. in the evening (INRIX, 2017). During these times, trips on I-25 can take up to three times longer than during non-congested periods. These delays result in economic losses and negatively impact the region's quality of life.

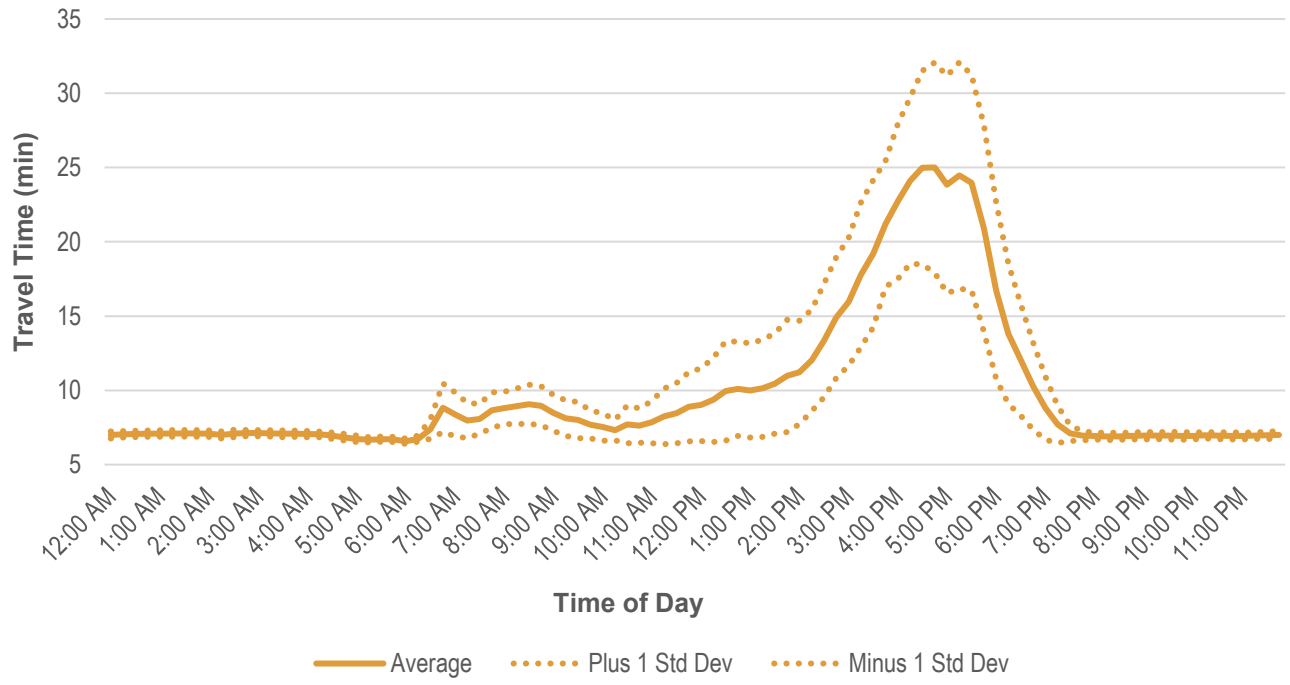
Traffic Growth

Congested conditions are expected to worsen in the future as Denver's population and travel demand continue to grow. By 2040, local and regional growth is expected to increase trip-making demand and traffic volumes on I-25 by at least 15 percent as compared to 2017 levels (DRCOG, 2017).

Improve Travel Time Reliability

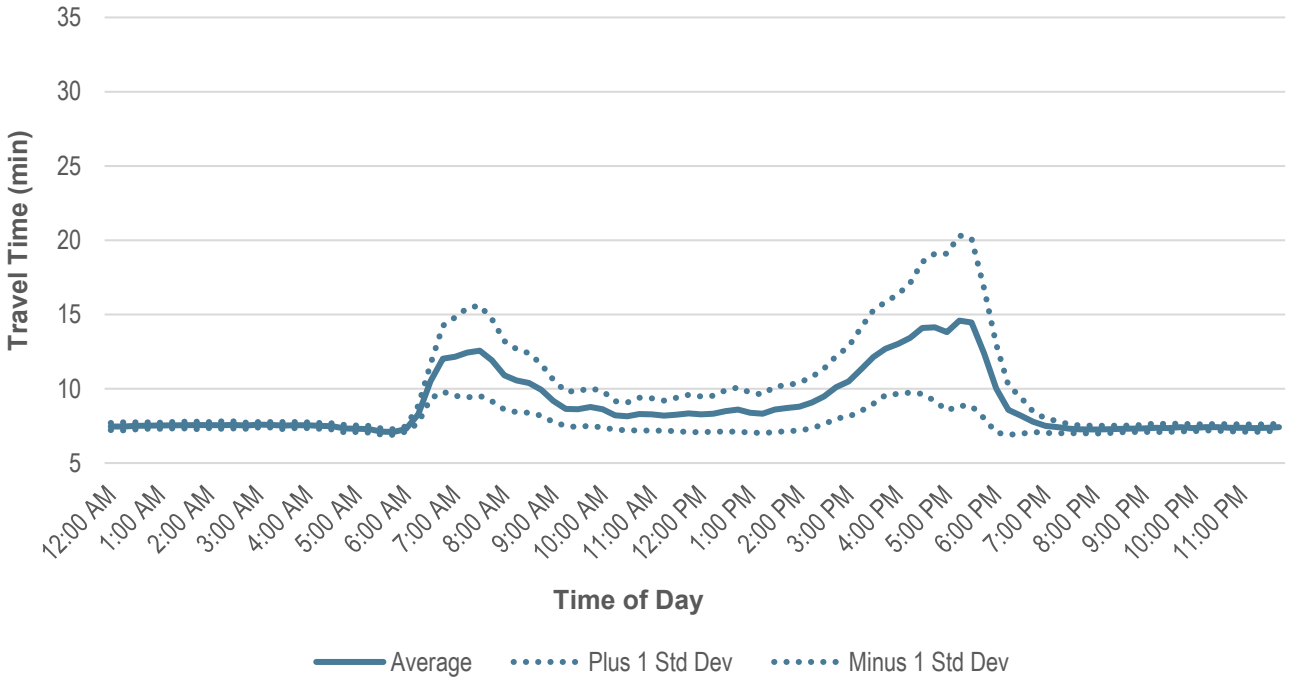
Travel times within the corridor are unpredictable, especially during the peak travel periods. Without traffic, a trip between Santa Fe Drive/US 85 and 20th Street takes about seven minutes. During normal peak periods, this same trip can take between 20 minutes and 30 minutes, or about three times as long. In addition to taking longer, these travel times can vary by more than 80 percent from one day to the next. Figure 16 and Figure 17 show the typical weekday travel times by time of day for the northbound and southbound directions, respectively. This unpredictability exacerbates congestion by making it more difficult to accurately plan trips, which leads to increased time lost and economic losses.

Figure 16 Northbound, Weekday I-25 Travel Times (from Broadway to Park Avenue)



Source: INRIX, 2017

Figure 17 Southbound, Weekday I-25 Travel Times (from Broadway to Park Avenue)



Source: INRIX, 2017

Three primary factors that contribute to low travel time reliability on the corridor have been identified, including crashes, incidents, and special events.

Crash-Related Reliability

The 1,000 documented crashes per year and additional breakdown-type incidents seriously impact travel reliability in the corridor. Each incident is estimated to cause four minutes of delay for every one minute in place. Beyond the regularly expected congestion, a major event—such as a sports game—or incident—such as a large crash requiring a full or partial freeway closure—occurs once every three to four days.

Incident Management

Substandard shoulder widths and lack of refuge areas provide few locations for disabled vehicles to be removed from travel lanes and hinder emergency response activities. This often results in closure of mainline freeway lanes during emergency-response activities, which increases the impact of crashes and incidents.

Special Events

Serving major downtown Denver event venues—such as sport stadiums and major theater and convention spaces—day-to-day travel demand for I-25 Central is impacted by a variety of special events. These events, which by their very nature do not occur at regular intervals or in the same combinations—result in additional traffic on I-25 and more unpredictable travel times. The corridor does not have adequate infrastructure to accommodate traffic associated with these types of events.

What were the additional considerations?

In addition to the three identified needs, two additional considerations were identified in the purpose statement for the I-25 Central PEL. These included optimizing access and improving cross connectivity. Although not direct needs of the freeway, these considerations play a key role in the overall transportation network, of which I-25 is a part. Therefore, it is important to weigh these considerations when identifying and evaluating potential solutions. Both of these considerations are discussed in greater detail in the following sections.

Optimize Access

The I-25 Central corridor serves a complex mix of traffic patterns that creates excessive vehicular weaving and lane maneuvers between entrance and exit ramps, resulting in turbulent, unreliable, and unsafe traffic operations along I-25. By optimizing access along the I-25 Central corridor, this turbulence can be reduced. The need to optimize access is supported by three key reasons: I-25's inability to meet its primary function, the current substandard access locations, and the current unsafe vehicle weaving operations.

I-25 Function and Access

As an access-controlled interstate highway, I-25's primary function is to efficiently and safely serve nationally and regionally oriented travel. The corridor must balance fulfilling this principal function with serving locally oriented travel. Existing access points along I-25 reflect the interaction or connection with the regional highway, regional arterial, and local roadway systems.

Within the corridor, there are nine access locations along I-25 (see Figure 7 in the Introduction chapter). Each connecting roadway provides a different function within the overall roadway system and is classified according to its function, ranging from U.S. highway, to regional arterial, to local street. Through a concept of hierarchy of movements, access locations with regional arterials generally are more essential and provide higher functionality than local street connections. In general, traffic volumes reflect this hierarchy, with regional arterials typically having higher travel demands than local streets, for example.

Table 4 provides an assessment of the existing I-25 access locations relative to their respective use, role, and function within the overall roadway system. At each existing location, an overall rating is provided regarding its priority and importance in connecting I-25 with the adjoining roadway network. As shown, not every existing access location is most appropriately served with direct access to/from I-25. Rebalancing access to and from the interstate is needed to ensure that I-25 can appropriately meet its primary function.

Table 4 Evaluation of Existing I-25 Access Locations

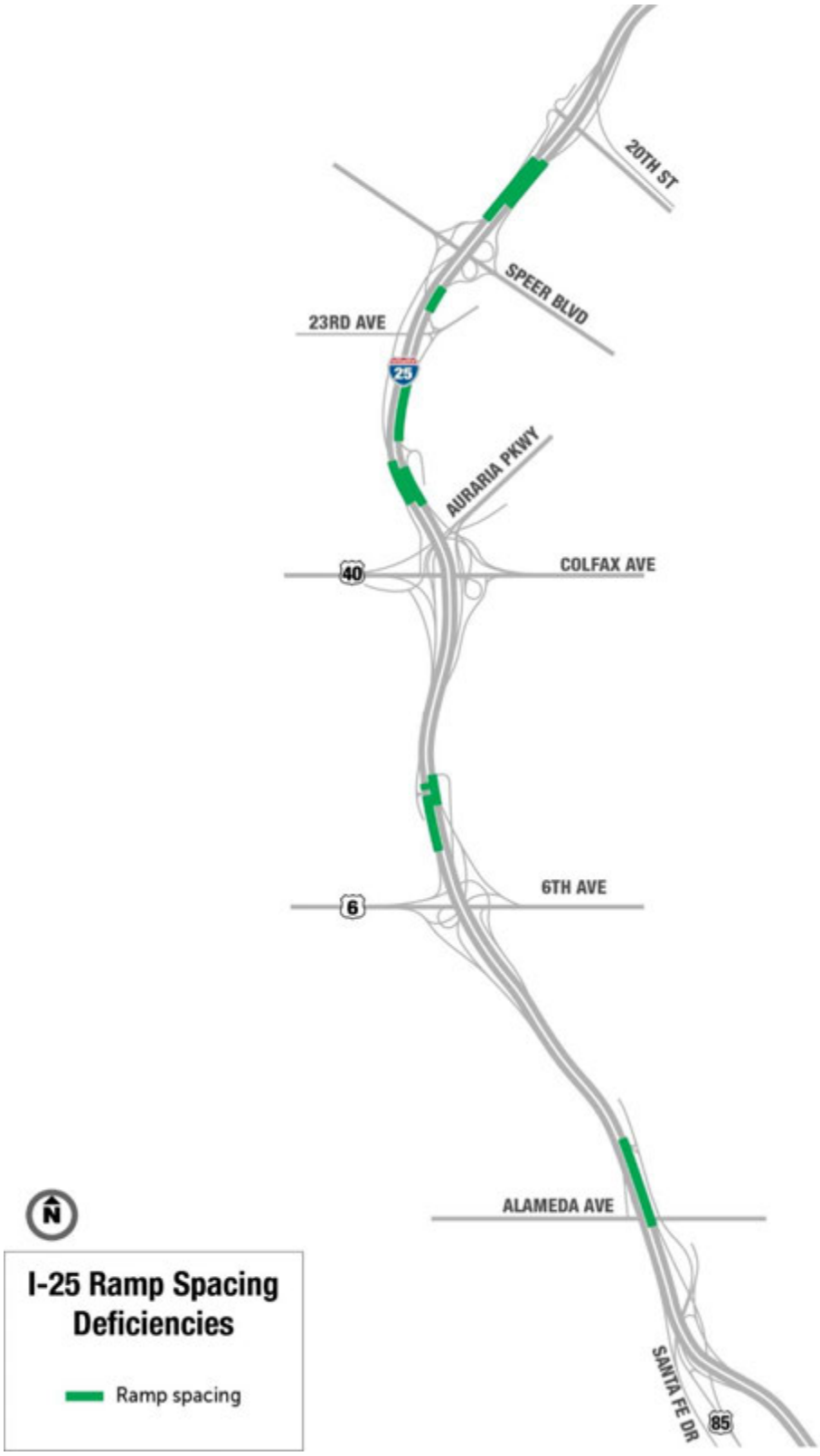
Access Location	Level of Traffic Demand (What are existing traffic volumes?)	Roadway Classification (What is the hierarchy of the roadway?)	Network Service (Does the roadway serve a large area?)	Overall Rating
20th Street[1]	Moderate	Moderate	Moderate	Moderate
Speer Boulevard	Moderate	Moderate	High	High
23rd Avenue	Moderate	Low	Low	Low
17th Avenue	Low	Low	Low	Low
Colfax Ave/Auraria Ave/Walnut Street	High	High	High	High
8th Avenue	Low	Moderate	Moderate	Moderate
US 6/6th Avenue	High	High	High	High
Alameda Avenue	Low	Moderate	High	Moderate
Santa Fe Drive/US 85	High	High	High	High

[1]This location includes a direct-connect ramp to/from the existing managed lanes to the north of the I-25 Central study area.
Note: Additional discussion about the methodology and outcomes of the access evaluation for I-25 Central can be found in Attachment C, Traffic and Safety Technical Report.

I-25 Weave Operations

Currently, multiple tightly spaced access points within the corridor do not provide adequate distance for vehicles to merge and weave. This negatively affects the traffic operations along I-25. Figure 18 presents the existing deficient weave areas between existing access locations along I-25. As shown, there are six deficient ramp weave areas in the northbound direction and three in the southbound direction. These short/deficient weave areas result in increased turbulence on the highway, which negatively impacts the safety and operations of I-25. Additional information, including the length of each weave area on I-25, is included in the *I-25 Central Roadway Geometrics Technical Memorandum* (July 2018), which is included in Attachment A, *Existing Conditions Assessment Report*.

Figure 18 Existing I-25 Ramp Spacing Deficiencies (20th Street to Santa Fe Drive/US 85)



Source: Existing geometric survey data were collected by the project team in 2017 (Project Team, 2017a). Geometric standards are based on the American Association of State Highway and Transportation Officials (AASHTO) guidelines (AASHTO, 2018).

Improve Cross Connectivity

The I-25 Central corridor serves a wide variety of travel modes and uses. In addition to vehicular traffic on I-25, cars, transit vehicles, bicycles, and pedestrians navigate along and across the corridor through a network of local streets, sidewalks, and trails. This existing interconnected system provides crossings over or under I-25 and connects travelers to adjacent and nearby neighborhoods and destinations. However, in their existing conditions, these crossings and connections are limited in nature and are sometimes spaced far apart. This negatively impacts the ability to cross the freeway, especially for those traveling by non-motorized modes of transportation—such as walking or bicycling—which are disproportionately impacted/influenced by out-of-direction travel.

The limited crossings of I-25 increase congestion on the freeway as more people choose to make trips by car—in response to excessive out-of-direction travel—and more car trips use the freeway—in response to a disconnected local roadway network.

Spacing of I-25 Crossings

Along the approximately 4.5-mile length of the I-25 Central corridor, there are 15 crossings that each accommodate a different mix of travel modes, including cars, trains, buses, bicycles, and pedestrians (see Table 5). This limited number of crossings results in I-25 creating a barrier for people needing to cross I-25 going east-west. This is especially true for non-motorized trips, such as those being made by walking or bicycling, which are more heavily impacted by out-of-direction travel.

Note that the most recent update of Denver Moves (Denver, 2019), Denver's city-wide long-range transportation plan, identifies the priority corridors for moving people through transit, sidewalks, trails, and bicycle facilities throughout the city. It identifies a number of priority corridors for non-motorized improvements that cross and interact with the I-25 Central corridor. These priority corridors include every existing crossing of I-25 except the RTD W Line, US 6/6th Avenue, BNSF Railway, and Santa Fe Drive/US 85 crossings, as well as a new crossing near Bayaud Avenue. By establishing a vision for the I-25 Central corridor, the I-25 Central PEL Study provides the opportunity to accommodate the crossing improvements/additions identified in Denver's Denver Moves plan.

Table 5 Existing I-25 Crossings

Cross Street/ Facility	Over/Under	Roadway Access to I-25	Bicycle/Pedestrian Facilities
20th Street*	Over	Yes	Bicycle: Eastbound 11.5-ft-wide multi-use path Pedestrian: Eastbound 11.5-ft-wide attached sidewalk Westbound 7-ft-wide attached sidewalk
Highland (16th Street) Pedestrian Bridge*	Over	No	Bicycle/Pedestrian: 2-way 13.5-ft-wide pedestrian bridge with multi-use path
15th Street*	Over	No	Bicycle: Eastbound shared-use lane Westbound 5-ft-wide bicycle lane Pedestrian: Eastbound 7.5-ft-wide attached sidewalk Westbound 10.5-ft-wide attached sidewalk
Speer Boulevard*	Over	Yes	Bicycle/Pedestrian: 2-way 10.5-ft-wide pedestrian bridge on south side of Speer Boulevard
23rd Avenue*	Over	Yes	Bicycle: Eastbound 5-ft-wide bicycle lane Westbound 5-ft-wide bicycle lane Pedestrian: Westbound 5.5-ft-wide attached sidewalk
17th Avenue/ South Platte River*	Under	Yes	Bicycle/Pedestrian: 2-way 10-ft-wide attached sidewalk/multi-use path
Auraria Parkway/ Colfax Avenue*	Over	Yes	Pedestrian: Eastbound 7-ft-wide attached sidewalk Westbound 8.5-ft-wide attached sidewalk
Walnut Street*	Under	No	None
RTD W Line	Under	No	Not applicable
13th Avenue*	Under	No	Bicycle: Eastbound 5.5-ft-wide bicycle lane Westbound 5.5-ft-wide bicycle lane
8th Avenue*	Under	Yes	Bicycle/Pedestrian: Eastbound 8-ft-wide multi-use path Westbound 8-ft-wide multi-use path
US 6/6th Avenue	Over	Yes	None
BNSF Railway	Under	No	Not applicable
Alameda Avenue*	Over	Yes	Bicycle: Westbound 7-ft-wide multi-use path Pedestrian: Eastbound 6-ft-wide attached sidewalk Westbound 7-ft-wide attached sidewalk
Santa Fe Drive/US 85	Under	Yes	None

** Identified as a priority non-motorized crossing in Denver Moves (Denver, 2019)*

Local Network Fragmentation

In general, the local roadway network around the I-25 Central corridor is laid out in a grid pattern. However, due to the barriers created by I-25, the South Platte River, and the railroads, this grid pattern is fragmented around I-25 itself with only a few facilities providing a continuous connection across all these barriers. Because of this fragmentation, travelers often use multiple facilities for a short distance to navigate the disjointed roadway network. This results in vehicles entering I-25 at one entrance and then exiting I-25 a short distance later, typically at one of the next one, two, or three consecutive off-ramps. These short trips increase the number of vehicles on the freeway on- and off-ramps—which contributes to long queues sometimes spilling back onto the mainline freeway—and increase the number of vehicles merging and weaving on the freeway. Both of these conditions contribute to the observed congestion and safety issues on I-25.

What are the goals and objectives of the improvements?

In addition to the specific needs, a number of goals and objectives were identified that further aided the definition and evaluation of the alternatives. These broader criteria provide an evaluation framework addressing the context of the corridor's setting, including adjacent environmental and land use considerations. These factors reflect both the themes and topics important to the study's stakeholders and the public, and issues important to CDOT and other agencies regarding implementation. These goals and objectives include:

Environment

- Are there impacts to the natural environment?
- Are there impacts to the social and built environment?

Future Flexibility and Technology

- Could the alternative accommodate future physical changes to the roadway (restriping, new lane assignments, new technology infrastructure, etc.)?

Planning Context

- How well does the alternative accommodate future land use changes?

Chapter 3 Development and Evaluation of Alternatives

A wide range of concepts that could improve I-25 were developed and refined through a multi-stepped evaluation process. This chapter documents the processes that were used to develop and evaluate alternatives.

The wide range of challenges, needs, goals, and objectives of the I-25 Central PEL led to the identification of many potential solutions. For the purposes of the PEL, these potential solutions were called "concepts." The PEL used a multi-step process to identify, evaluate, and refine concepts and alternatives. Process steps were referred to as Level 1, Level 2, and Level 3 evaluation. At each level of evaluation, concepts and alternatives were assessed in a progressively more detailed way that built upon the findings and outcomes of previous levels of evaluation.

Additional information about the identification of concepts, development of alternatives, and evaluation process is provided in Attachment B, ***Alternatives Evaluation Technical Report.***

How were alternative concepts identified?

Before any evaluation could be completed, concepts to meet the project's purpose and address the needs and goals of the corridor were identified. These concepts were developed through a series of brainstorming discussions and interviews with industry thought leaders, key project stakeholders, study team members, and the Stakeholder Focus Group (SFG). Concepts were intentionally broad to encompass all of the ideas and challenges identified by stakeholders. A list of identified concepts and brief descriptions are provided in Table 6.

How were alternative concepts evaluated?

A three-level evaluation process was used to evaluate concepts and alternatives. The first level of evaluation consisted of a high-level review to see if the concepts met the project's Purpose and Need. The second level of evaluation determined how well the concepts met the project's goals and objectives. The third level of evaluation packaged individual concepts into more-defined, complete alternatives consisting of corridor-wide improvements and evaluated the trade-offs between the benefits gained from a specific alternative versus the potential impacts of the alternative.

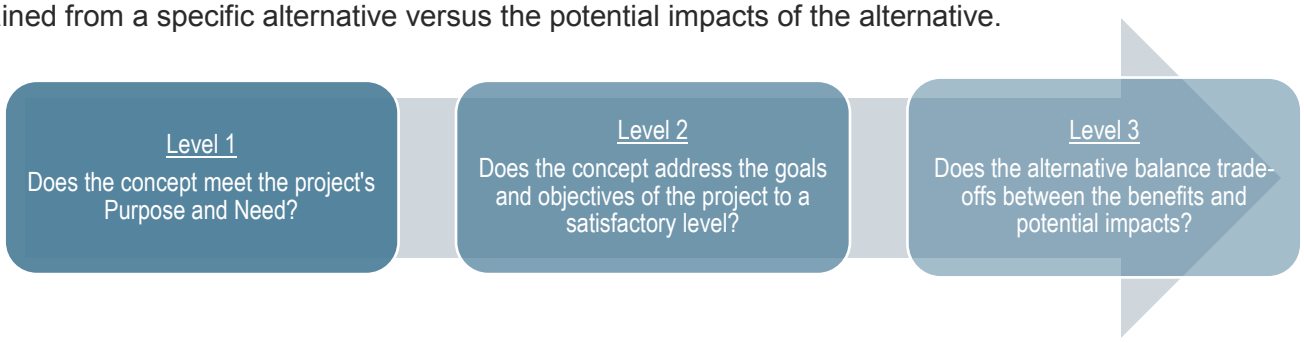


Table 6 Identified Concepts for Improvements to I-25 Central

Concept	Description	Primary Reason(s) for Consideration
No Action	This concept presents the expected future condition if no action is taken. This includes reasonably planned mobility improvements in the region within the 2040 regional planning horizon as identified in the DRCOG 2040 Fiscally Constrained Regional Transportation Plan. On I-25 Central, this includes interchange capacity improvements at the I-25 and Broadway interchange. This alternative is not the same as the existing conditions. Note that the DRCOG 2040 Fiscally Constrained Regional Transportation Plan also includes the addition of one new general-purpose travel lane in each direction on I-25 between Santa Fe Drive/US 85 and US 6/6th Avenue. For the purposes of this study, this improvement was intentionally omitted from the No Action concept. This was done because one of the desired outcomes of this study was to determine if this recommended improvement is still warranted given any additional recommendations made as part of this study.	This concept provides a baseline against which all other concepts are measured.
I-25 Reroute with Urban Boulevard	This concept would include the rerouting of regional traffic around the urban core of Denver and replacement of the existing I-25 freeway with an urban boulevard. Regional traffic would be rerouted east using I-76, I-70, and I-225. A signalized urban boulevard would be created from approximately 20th Street to Santa Fe Drive/US 85 that connects to the existing surface grid.	Removing the highway from the urban core of Denver could allow for better cross connections to be made between neighborhoods and could provide more space adjacent to the South Platte River.
Lane Reductions	This concept would provide removal of travel lanes to provide space within the existing ROW in which a more standard highway cross section could be created.	Improving the highway cross section could improve safety and provide the space needed for first responders to safely access crash sites.
Shoulder Lane Use	This concept would bring the highway shoulders up to standard, or construct new shoulders as needed to be used as flexible travel lanes during peak periods. Current shoulder space is inconsistent along the existing freeway between 20th Street and Santa Fe Drive/US 85.	Improving and adding shoulders for use as travel lanes during the peak periods could improve congestion and provide space for first responders to safely access crash sites.
I-25 Geometric Refinements	This concept would provide geometric refinements by acquiring needed property (ROW) along the existing alignment. The intent of this alternative is to implement a more standard cross section (if achievable) with standard lane widths, shoulders, ramp lengths, etc., while minimizing the amount of new ROW required.	There may be areas along I-25 in which only a small amount of ROW is required to provide major improvements to the highway.

Table 6 Identified Concepts for Improvements to I-25 Central

Concept	Description	Primary Reason(s) for Consideration
I-25 Geometric Improvements	This concept would provide major alignment alterations, such as implementing a more standard cross section, improved on- and off-ramp configurations, straightening curves, etc.	Bringing the geometry of the highway up to current design standards could improve safety, enhance travel time reliability, and reduce congestion.
I-25 Realignment	This concept would provide substantial realignment of the highway away from the existing ROW constraints including the South Platte River and the BNSF Railway railroad tracks.	Removing the highway from the current constraints of the existing corridor (including the South Platte River, the freight rail lines, etc.) may allow it to be fully reconstructed in a way that meets current and future needs.
Lane Conversion	This concept would convert existing general-purpose lanes to managed lanes.	Converting existing lanes into managed lanes may provide I-25 users with a travel option that provides a more reliable travel time without the need to expand the highway.
Additional General-Purpose Lanes	This concept would add travel lanes to the freeway that could be used by any driver or vehicle type.	Providing additional travel lanes may help meet current and future travel demand and reduce congestion.
Added Managed Lanes	This concept would add travel lanes to the highway that could be used by regional (through) traffic or managed for specific users, such as high-occupancy vehicles (HOV), tolled vehicles, etc.	Adding managed lanes may provide I-25 users with a travel option that provides a more reliable travel time.
Dedicated Transit Lanes	This concept would add travel lanes to the highway that are for transit only (bus, express bus, bus rapid transit, or other new technology type, etc.).	Adding transit lanes could promote travel mode shift away from single-occupancy vehicles, thus reducing congestion on I-25 and providing a more reliable travel time option through the corridor.
Collector/Distributor Roads	This concept would add a system of roads adjacent to the highway that could allow for the consolidation of access.	Consolidating access could reduce congestion and improve safety on the highway.
Multi-Level Highway	This concept would involve reconstructing the existing I-25 as a viaduct (elevated), a tunnel, or an open lowered freeway. These improvements may be consistent throughout the corridor or only proposed in specific segments.	Creating multiple levels to the highway could create space for new amenities (such as park space), more standard geometric elements (such as shoulders to provide space for first responders), and/or space for additional travel lanes, all while minimizing the need for additional ROW.

Table 6 Identified Concepts for Improvements to I-25 Central

Concept	Description	Primary Reason(s) for Consideration
Transportation Demand Management (TDM), Operational, and Intelligent Transportation Systems (ITS)	This concept would include strategies designed to reduce travel demand and improve the use of the current transportation system. TDM programs provide user information, offer incentives, and encourage behavior change to reduce travel demand. ITS improvements may include active traffic management, variable message signs, and variable speed limits to help improve traffic flow on the existing transportation system.	TDM strategies and ITS improvements could address traffic congestion by reducing travel demand rather than increasing transportation capacity, thus reducing the need for major capital investment.
Congestion Pricing	This concept would provide a mechanism to reduce peak congestion by shifting trips to off-peak times or reducing trips during peak times using variable charges during the commuter peaks. These charges may apply to specific lanes of a roadway (similar to express toll lanes); variable tolls on an entire roadway; cordon charges that require a toll to enter a congested area of the city; or per mile charges in a specific congested area.	Charging people to travel during the most congested times of the day may reduce the travel demand for I-25, thus potentially improving safety, congestion, and travel time reliability without the need to expand the highway.
New Transit Facility	This concept would provide constructing a high-capacity transit facility (rail or other new technology type). The new transit facility may be located adjacent to the I-25 corridor (in new ROW) or follow another corridor in the region, depending on the transit corridors' ability to serve similar origins and destinations as I-25.	Adding transit facilities could promote travel mode shift away from single-occupancy vehicles, thus reducing congestion on I-25 and providing a more reliable travel time option through the corridor.

Level 1 Evaluation

The purpose of the Level 1 evaluation process was to determine if concepts met the project's Purpose and Need. This was done by using a series of five qualitative evaluation questions that were based on the project's Purpose and Need statement. These include:

- Safety: Does the concept improve safety on the I-25 mainline, on the I-25 on- or off-ramps, and/or at the I-25 ramp terminals?
- Congestion: Does the concept reduce congestion on the I-25 mainline, on the I-25 on- or off-ramps, and/or at the I-25 ramp terminals?
- Travel Time Reliability: Does the concept improve travel time reliability on the I-25 mainline?
- Access: Does the concept improve access to and/or from I-25?
- Cross Connectivity: Does the concept improve connectivity across I-25 for bicyclists, pedestrians, transit, and/or local vehicle traffic?

Based on a qualitative evaluation, each concept received one of three responses to each of the evaluation questions: yes, neutral, or no. A "yes" response indicated the concept would meet or has the potential to meet the criterion in question. A "neutral" response indicated the concept likely would not affect the criterion in question. A "no" response indicated that the concept likely would negatively affect the criterion in question.

From these responses, a concept was either carried forward, eliminated as a standalone alternative, or eliminated. A concept that was carried forward was progressed into the Level 2 evaluation. A concept that was eliminated as a standalone alternative was removed from consideration, but specific elements were carried forward for incorporation into other refined concepts in the Level 2 evaluation. If a concept was eliminated, then no element unique to that concept was moved forward into future levels of evaluation and the concept was not recommended for implementation on I-25. Table 7 summarizes the outcomes of the Level 1 evaluation.

Concepts Eliminated Following the Level 1 Evaluation

There were two concepts eliminated and not evaluated further and one concept eliminated as a standalone alternative following the Level 1 evaluation process. These are listed below and are shown in Table 7:

- I-25 Reroute with Urban Boulevard concept was eliminated because it did not meet the safety, congestion, or travel time reliability elements of the PEL's Purpose and Need statement
- Lane Reductions concept was eliminated because it did not meet the congestion element of the PEL's Purpose and Need

Shoulder Lane Use concept was eliminated as a standalone alternative as it did not meet the safety portion of the Purpose and Need. It was considered possible that utilizing the shoulder as a travel lane for certain uses or during certain periods of time still could be considered as an element of another concept if that concept was able to address the identified safety concerns.

Table 7 Summary of Level 1 Evaluation

Concept	Safety	Congestion	Travel Time Reliability	Access	Cross Connectivity	Summary of Results
No Action	Neutral	Neutral	Neutral	Neutral	Neutral	Carried Forward
I-25 Reroute with Urban Boulevard	No	No	No	Neutral	Neutral	Eliminated
Lane Reductions	Neutral	No	Yes	Neutral	Neutral	Eliminated
Shoulder Lane Use	No	Yes	Neutral	Neutral	Neutral	Eliminated as a Standalone Alternative
I-25 Geometric Refinements	Yes	Yes	Yes	Yes	Neutral	Carried Forward
I-25 Geometric Improvements	Yes	Yes	Yes	Yes	Neutral	Carried Forward
I-25 Realignment	Yes	Yes	Yes	Neutral	Neutral	Carried Forward
Additional General-Purpose Lanes	Yes	Yes	Yes	Neutral	Neutral	Carried Forward
Lane Conversion	Neutral	Neutral	Yes	Neutral	Neutral	Carried Forward
Added Express Lanes	Neutral	Yes	Yes	Neutral	Neutral	Carried Forward
Collector/Distributor Roads	Yes	Yes	Neutral	Yes	Yes	Carried Forward
Dedicated Transit Lanes	Yes	Yes	Yes	Neutral	Neutral	Carried Forward
New Transit Facility	Yes	Yes	Yes	Neutral	Neutral	Carried Forward
Multi-Level Highway	Yes	Yes	Yes	Yes	Yes	Carried Forward
TDM, Operational, and ITS	Yes	Yes	Yes	Neutral	Neutral	Carried Forward
Congestion Pricing	Yes	Yes	Yes	Neutral	Neutral	Carried Forward

Refinement of Concepts Between the Level 1 and Level 2 Evaluations

Using the outcomes of the Level 1 evaluation, concepts were further refined and evaluated at a higher level of detail in the Level 2 evaluation. This refinement resulted in some Level 1 concepts being combined to create a single Level 2 concept, some Level 1 concepts being split into multiple Level 2 concepts, and some Level 1 concepts being carried forward as is into Level 2. In general, combining, splitting, or carrying concepts forward provided a way to maximize the potential to best meet the project's goals and objectives.

Note that the "Lane Conversion" concept carried forward from Level 1 was reconsidered at the beginning of the Level 2 evaluation process and the project team determined that it should not be independently evaluated as a concept in Level 2 since it only had the potential to improve conditions for one of the core considerations, travel time reliability. Although eliminated as a standalone, it is possible the concept of converting an existing travel lane to a managed lane or another use still could be considered as an element of another concept or alternative. A list of and a brief description about each Level 2 concept is provided in Table 8.

Table 8 Concepts Evaluated in Level 2

Level 2 Concept	Description
Congestion Pricing	This concept was carried forward from Level 1 and would provide implementing a mechanism to reduce peak congestion by shifting or reducing trips to off-peak times. One variation of this may include implementing variable charges during the commuter peaks.
Operations and Demand Management	This concept stemmed from the TDM and ITS concept evaluated in Level 1 and would provide implementing strategies designed to reduce travel demand and improve the use of the current transportation system, rather than investing in major capital improvements.
Bring the Corridor to Standard	This concept combined the I-25 Geometric Refinements and the I-25 Geometric Improvements concepts into one single concept for Level 2 evaluation.
Add Collector/Distributor Roads	This concept stemmed from the Collector/Distributor Roads concept in Level 1 and would add a system of roads adjacent to the I-25 Central corridor allowing for management of access to/from the interstate.
Add Braided Ramps	This concept originated from the Collector/Distributor concept in Level 1 and would provide braiding on- and off-ramps to separate traffic entering and exiting I-25 at various interchanges.
New Transit Facilities	This concept was carried forward "as-is" from Level 1 and would provide investment in major transit improvements that could increase transit use. High-capacity transit on Federal Boulevard, Broadway, and Lincoln Street, as well as additional light rail transit capacity adjacent to the existing light rail transit tracks from Broadway to Colfax Avenue, are the key projects proposed.
Add General-Purpose Lanes (One)	This concept was carried forward "as-is" from the Level 1 evaluation and would add one new general-purpose lane to I-25 in each direction.
Add Managed Lanes	This concept is a combination of the Add Express Lanes and Dedicated Transit Lanes concepts evaluated in Level 1. It would add one or more managed lanes to I-25 in each direction, extending from Santa Fe Drive/US 85 to 20th Street.

Table 8 Concepts Evaluated in Level 2

Level 2 Concept	Description
Realign and Split the Corridor	This concept stemmed from the Level 1 I-25 Realignment concept and would move the southbound lanes of I-25 to the west side of the South Platte River between Alameda Avenue and US 6/6th Avenue. The existing I-25 alignment would only serve northbound traffic, and its footprint could be narrowed to provide more space to the South Platte River Greenway or additional space to the adjacent freight railroad corridor.
Add General-Purpose Lanes (Two)	This concept was carried forward "as-is" from the Level 1 evaluation and would add two new general-purpose lanes to I-25 in each direction.
Construct a Tunnel	This concept is a combination of the Multi-Level Highway and Add Express Lanes concept in Level 1 and would move traffic traveling through I-25 Central (not entering or exiting along this segment of I-25) into a tunnel.
Construct a Multi-Level Highway	This concept stems from the Multi-Level Highway concept evaluated in Level 1 and would grade-separate traffic using different multi-level solutions within the I-25 Central corridor, including viaducts and lowered highway sections.
Realign Adjacent to RTD C, D, E, F & H light rail lines	This concept stems from the Level 1 I-25 Realignment Concept and would realign the highway to be next to the existing RTD light rail tracks between approximately Santa Fe Drive/US 85 and Colfax Avenue. This would allow the highway to be reconstructed to improve capacity and geometry. This concept also includes space for new RTD light rail tracks to increase transit capacity and removed the interstate from the east side of the river—between approximately Santa Fe Drive/US 85 and Colfax Avenue—allowing that space to be repurposed.

Level 2 Evaluation

The Level 2 evaluation process was primarily structured around the project's goals and objectives. These goals and objectives were summarized into seven categories that included safety, congestion, travel time reliability, access, environment, crossings of I-25, and future flexibility and technology. In addition to these goals and objectives, overall feasibility/constructability of a concept also was considered. Based on a concept's ability to meet the identified criteria, it then was either carried forward into Level 3 evaluation for further analysis, or it was eliminated. If a concept was eliminated, then no further analysis was performed. Table 9 summarizes the outcomes of the Level 2 evaluation.

Table 9 Level 2 Evaluation Results

Concept	Level 2 Evaluation Outcome	Discussion
No Action	Carried Forward	Although this concept does not address many of the goals and objectives of this study, it was carried forward to provide a baseline for comparison.
Congestion Pricing	Carried Forward	This concept was not recommended as a standalone concept because, on its own, it does not adequately address the identified safety issues along the corridor. However, the concept of congestion pricing could be incorporated into other concepts.
Operations and Demand Management	Carried Forward	This concept was not recommended as a standalone concept because, on its own, it does not adequately address the identified safety issues along the corridor. However, the concept of operations and demand management could be incorporated into other concepts.
Bring the Corridor to Standard	Carried Forward	This concept was not recommended as a primary treatment because its potential benefits to congestion and travel time reliability do not balance out the potential construction and environmental considerations. However, the concept of bringing the highway to standard is be incorporated into other concepts.
Add Collector/ Distributor Roads	Carried Forward	This concept was carried forward because its potential benefits to safety, congestion, and access likely balance its potential construction and environmental considerations.
Add Braided Ramps	Carried Forward	This concept was carried forward because its potential benefits to safety, congestion, and access likely balance its potential construction and environmental considerations.
New Transit Facilities	Carried Forward	This concept was not recommended as a primary treatment because its potential benefits to congestion do not balance out the constructability considerations. However, the concept of providing transit improvements could be incorporated into other concepts.
Add General-Purpose Lanes (One)	Carried Forward	This concept was carried forward because its potential benefits to safety and congestion likely balance its potential construction and environmental considerations.
Add Managed Lanes	Carried Forward	This concept was carried forward because its potential benefits to safety, congestion, and travel time reliability likely balance its potential construction and environmental considerations.
Realign and Split the Corridor	Carried Forward	This concept was not recommended as a primary treatment because its potential benefits to safety and congestion do not balance out the required new ROW, construction, and environmental considerations. However, the concept of realigning smaller portions of the highway could be incorporated into other concepts.

Table 9 Level 2 Evaluation Results

Concept	Level 2 Evaluation Outcome	Discussion
Add General-Purpose Lanes (Two)	Carried Forward	This concept was carried forward as a primary treatment because its potential benefits to safety and congestion likely balance its potential construction and environmental considerations.
Construct a Tunnel	Eliminated	This concept was considered infeasible at this time due to the extreme construction, operations, and maintenance costs of building and operating a tunnel of this length.
Construct a Multi-Level Highway	Carried Forward	This concept was not recommended as a primary treatment because its potential benefits to safety and congestion do not balance out the construction and environmental considerations. However, the concept of having smaller portions of the highway in a multi-level configuration could be incorporated into other concepts.
Realign Adjacent to RTD C, D, E, F & H light rail lines	Carried Forward	This concept was not recommended as a primary treatment because its potential benefits to safety and congestion do not balance out the construction and environmental considerations. However, the concept of realigning smaller portions of the highway could be incorporated into other concepts.

Refinement of Level 2 Concepts into Standalone Alternatives

The Level 1 and Level 2 evaluations examined individual improvement concepts. Following the conclusion of the Level 2 evaluation, the remaining concepts then were packaged together to form standalone alternatives. These alternatives identified specific improvements in specific areas and provided enough detail to perform quantitative trade-off analysis.

In total, four distinct alternatives were identified. These included the following, which are described below:

1. No Action Alternative
2. Bring the Corridor to Standard Alternative
3. Collector/Distributor and Braided Ramps Alternative
4. Managed Lanes Alternative

Note that the alternatives evaluated in Level 3 reflect only a few of the potential improvement options for I-25 Central and were created only to allow for more-detailed analysis. All concepts carried forward from the Level 2 evaluation still are recommended for further evaluation and potential implementation pending the results of additional, more detailed future studies.

No Action Alternative

This alternative represents the baseline condition against which all other alternatives were compared. This alternative was formulated around the scenario in which no improvements are made to I-25 Central. Note that, although this alternative assumes no improvements are made to I-25 Central, it does assume that other planned improvements—as identified in the Denver Regional Council of Governments (DRCOG) 2040 Fiscally Constrained Regional Transportation Plan—are made to the surrounding roadway network. A list of these improvements is provided below.

- Reconfiguration of the Broadway and I-25 interchange
- Improvements to I-70 east of I-25 as part of the Central 70 project
- Lane reductions on Broadway between Cherry Creek and approximately I-25 to implement a two-way protected bicycle track
- Additional travel lanes on Federal Boulevard between 7th Avenue and West Holden Place
- Lane reductions on Colfax Avenue between approximately 15th Street and Grant Street to implement the Colfax Bus Rapid Transit project
- Additional travel lanes on Washington Street between approximately I-70 and 58th Avenue
- Reconfiguration of the Alameda Avenue bridge over the South Platte River and the surrounding intersections

Figure 19 provides an overview of this alternative.

Figure 19 No Action Alternative

Bring the Corridor to Standard Alternative

Much of the existing I-25 corridor has substandard geometric elements, including shoulder widths, roadway curvature, stopping sight distance, and ramp spacing. This alternative proposes to address the defined deficiencies identified in the *Existing Conditions Assessment Report* (Attachment A) by providing all necessary geometric improvements to the highway to meet FHWA Controlling Criteria engineering standards for the Interstate Highway System.

The prevailing cross section of this alternative is four general-purpose lanes, not including acceleration and deceleration lanes, with full-width inside and outside shoulders in each direction. In addition to the transportation network changes in the No Action Alternative, improvements provided in this alternative include:

- Full-width inside and outside shoulders on the mainline
- Standard-width travel lanes
- Sufficient stopping sight distance
- Increased space between interstate access locations
- Standard acceleration and deceleration lanes at all ramps
- Revision of the mainline alignment to reduce curves on I-25
- Reconstruction of bridge structures to address height clearance issues and accommodate the widening of I-25

Figure 20 and Figure 21 provide an overview of this alternative.

FHWA Controlling Criteria

FHWA's controlling criteria are a list of critical design elements. Any time improvements or changes are made to the Interstate Highway System (of which I-25 Central is a part), they are required to address all controlling citeria and bring the roadway elements up to current engineering design standards. The most current FHWA controlling criteria, as of 2016, include:

- Design speed
- Lane width
- Shoulder Width
- Horizontal curve radius (the sharpness of curves)
- Superelevation rate (how much the road tilts one way or another around a curve)
- Stopping sight distance
- Maximum grade (how steep the roadway can be)
- Cross slope (how much the road must be pitched to allow for good drainage)
- Vertical clearance
- Design loading structural capacity (how much weight the roadway must be able to handle)

Figure 20 Bring the Corridor to Standard Alternative

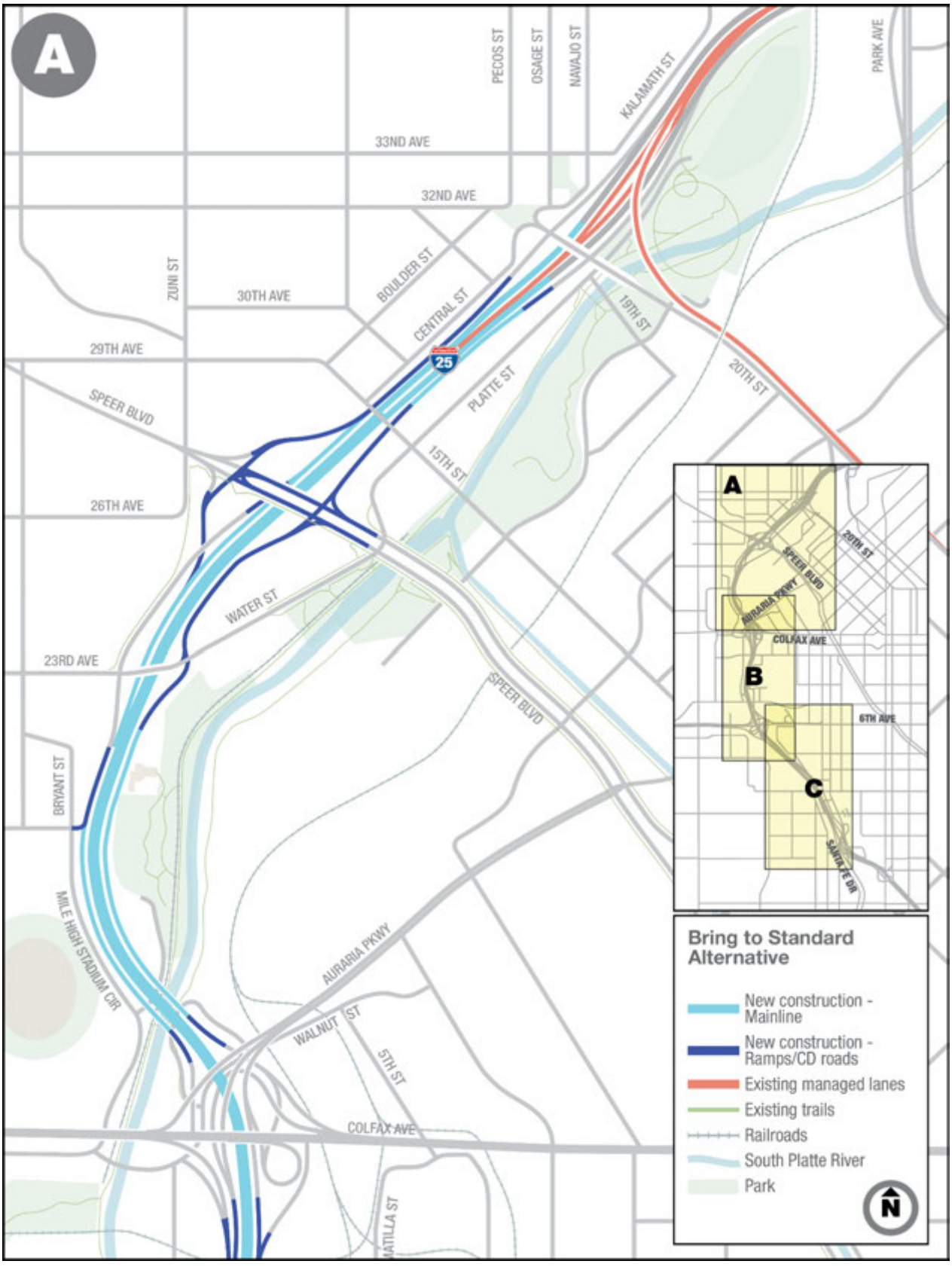
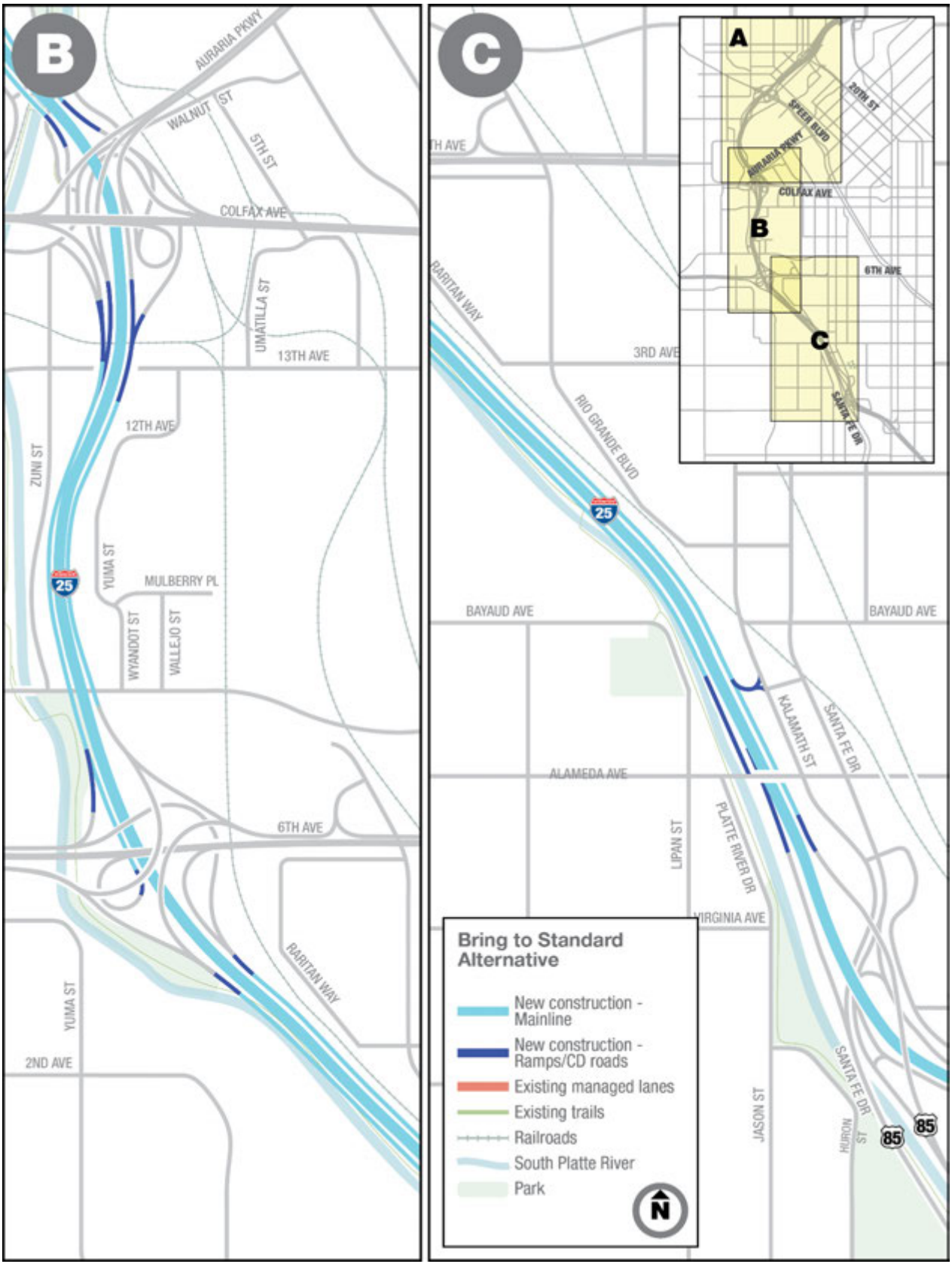


Figure 21 Bring the Corridor to Standard Alternative (Continued)



Collector/Distributor Roads and Braided Ramps Alternative

This alternative includes all geometric improvements (e.g., shoulder width, mainline alignment, etc.) proposed in the Bring the Corridor to Standard Alternative and proposes new collector/distributor roads to be constructed along each side of I-25 from 20th Street to Santa Fe Drive/US 85 in conjunction with braided ramps to allow for management of access to/from I-25. A list of the general improvements provided in this alternative is provided below.

- All improvements included in the No Action Alternative
- All geometric improvements provided in the Bring the Corridor to Standard Alternative
- Collector/distributor roads
  - Northbound
    - Santa Fe Drive/US 85 to US 6/6th Avenue
    - US 6/6th Avenue to Colfax Avenue/Auraria Parkway
    - 23rd Avenue to 20th Street
  - Southbound
    - 20th Street to 17th Avenue
    - Colfax Avenue/Auraria Parkway/Lower Colfax Avenue to US 6/6th Avenue
    - US 6/6th Avenue to Santa Fe Drive/US 85
- Braided Ramps
  - Northbound
    - Between the Santa Fe Drive/US 85 to US 6/6th Avenue collector/distributor road on-ramp to northbound
      I-25 and the northbound I-25 off-ramp to US 6/6th Avenue
    - Between the northbound I-25 off-ramp to the US 6/6th Avenue to Colfax Avenue/Auraria Parkway collector/distributor road and the US 6/6th Avenue on-ramp to northbound I-25
    - Between the Colfax Avenue on-ramp to northbound I-25 and the northbound I-25 off-ramp to the 23rd Avenue to 20th Street collector/distributor road
    - Between the Speer Boulevard on-ramp to northbound I-25 and the 23rd Avenue to 20th Street collector/distributor road
  - Southbound
    - Between the Speer Boulevard on-ramp to the southbound 20th Street to 17th Avenue collector/distributor road and the 20th Street to 17th Avenue collector/distributor road off-ramp to 23rd Avenue
    - Between the 23rd Avenue to 17th Avenue collector/distributor road on-ramp to southbound I-25 and the southbound I-25 off-ramp to the Colfax Avenue to US 6/6th Avenue collector/distributor road
    - Between the Colfax Avenue, Auraria Parkway, and Lower Colfax Avenue on-ramps to southbound I-25 and the Colfax Avenue to US 6/6th Avenue collector/distributor road
    - Between the US 6/6th Avenue on-ramp to southbound I-25 and the southbound I-25 off-ramp to the US 6/6th Avenue to Santa Fe Drive/US 85 collector/distributor road

Figure 22 and Figure 23 provide an overview of this alternative.

Figure 22 Collector/Distributor Roads and Braided Ramps Alternative

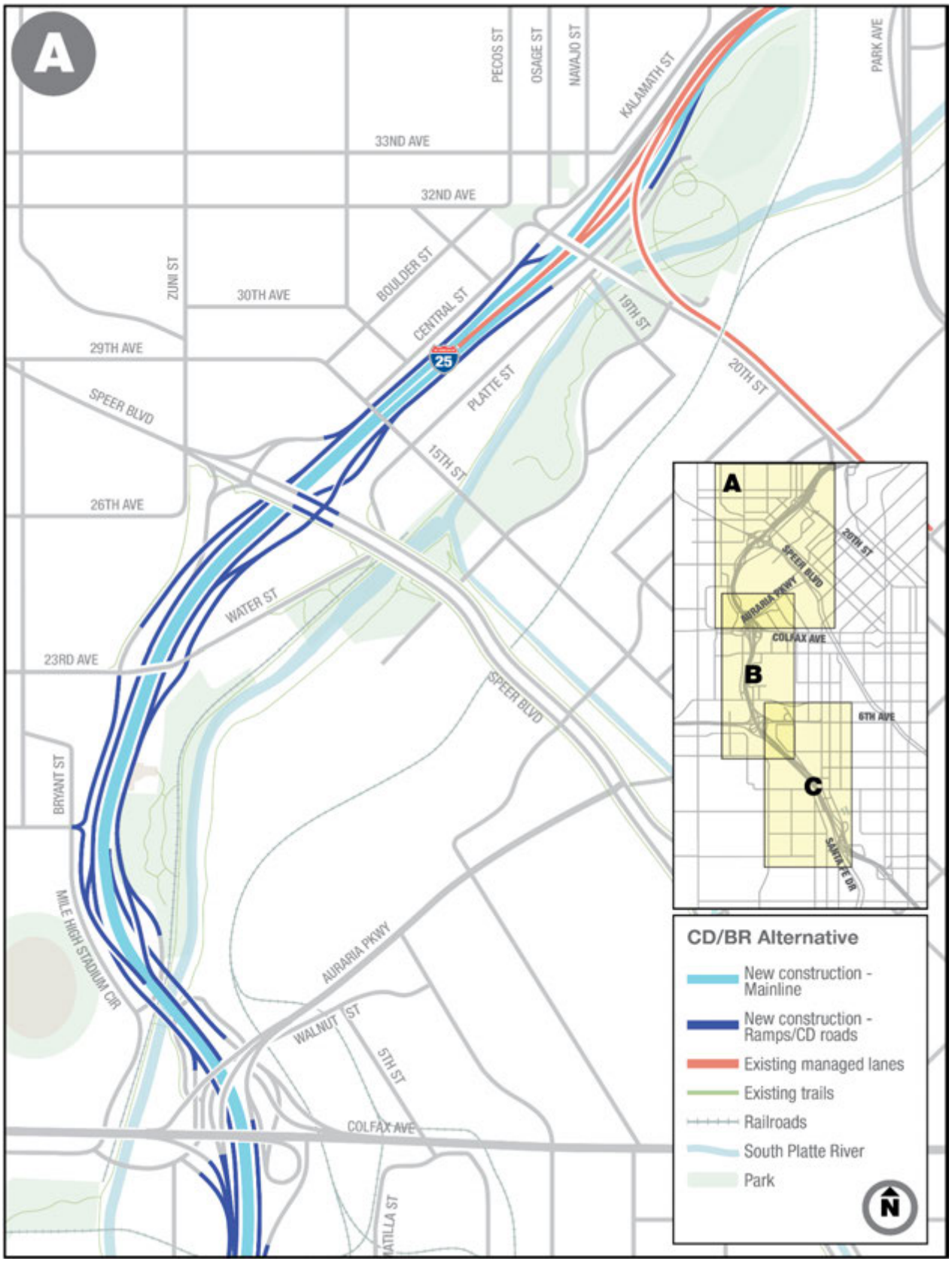
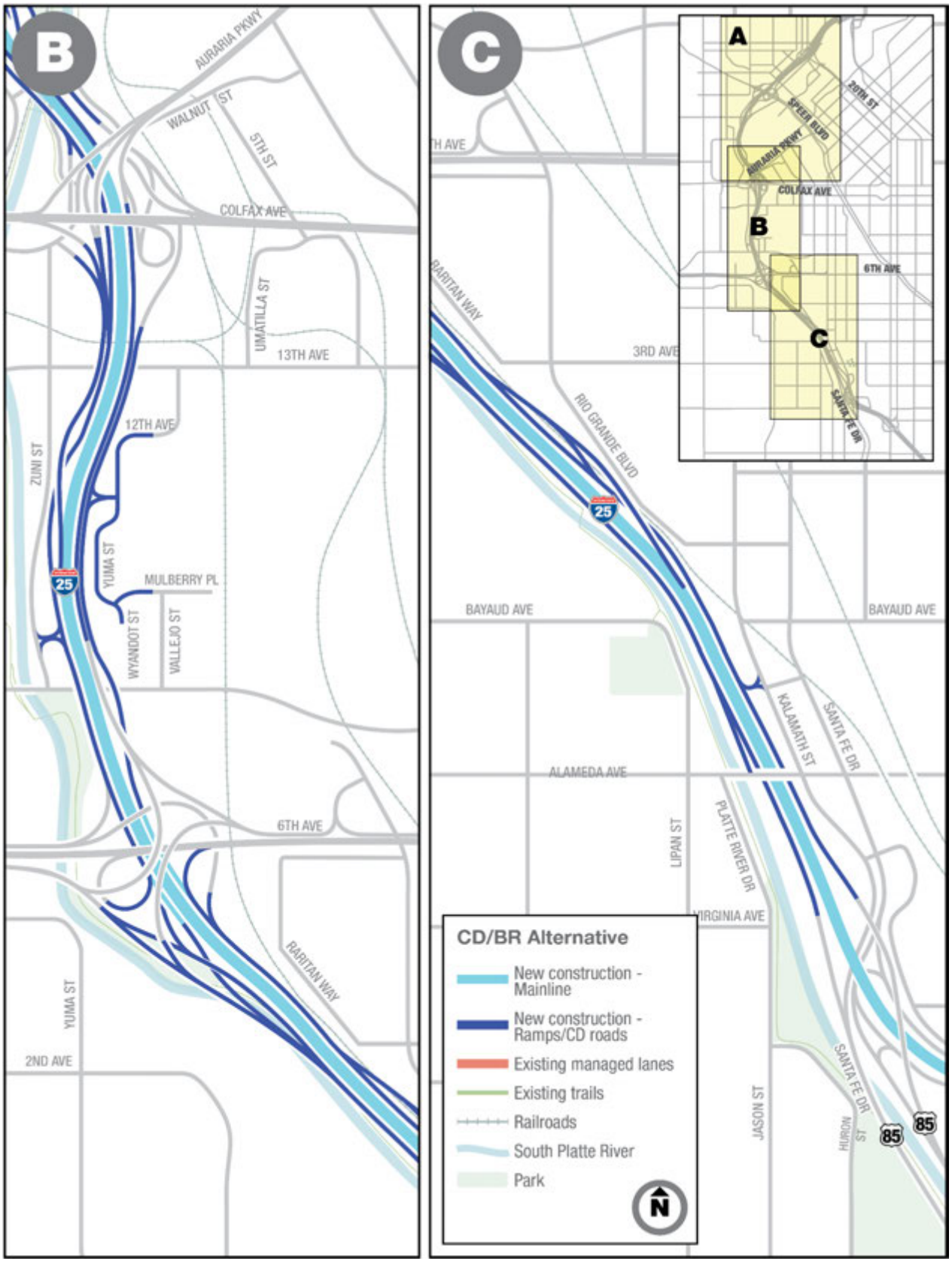


Figure 23 Collector/Distributor Roads and Braided Ramps Alternative (Continued)



Managed Lanes Alternative

This alternative proposes new managed lanes along I-25 consistent with CDOT's High Performance Transportation Enterprise (HPTE) *Express Lanes Master Plan* (CDOT/HPTE, 2020). The managed lanes are proposed to extend from approximately Santa Fe Drive/US 85 to the existing reversible managed lanes, north of 20th Street, running in both the northbound and southbound directions. In addition to adding managed lanes, this alternative would include geometric improvements provided in the Bring the Corridor to Standard Alternative, and some of the collector/distributor roads and braided ramps proposed in the Collector/Distributor Roads and Braided Ramps Alternative. A list of the general improvements provided in this alternative is provided below.

- All improvements included in the No Action Alternative
- All geometric improvements provided in the Bring the Corridor to Standard Alternative
- One new managed lane in both the northbound and southbound directions from the existing managed lanes near 20th Street to approximately Santa Fe Drive/US 85.
- Direct connection ramps from the managed lanes to crossing roadway facilities at the following locations:
  - Northbound
    - Eastbound and westbound US 6/6th Avenue on-ramp to the northbound I-25 managed lane
    - Northbound I-25 managed lane off-ramp to Colfax Avenue and Auraria Parkway
  - Southbound
    - Auraria Parkway on-ramp to the southbound I-25 managed lane
    - Speer Boulevard on-/off-ramp to/from the managed lanes to the north. This ramp was modeled as a reversible ramp serving southbound I-25 managed lane off-ramp traffic to Speer Boulevard during the AM peak period and then serving Speer Boulevard on-ramp traffic to the northbound I-25 managed lane during the PM peak period.
- Northbound collector/distributor road from 23rd Avenue to 20th Street
- Southbound collector/distributor road from 20th Street to Speer Boulevard

Although this alternative's defining characteristic in the implementation of managed lanes, note that this alternative is intended to more generally reflect the potential impacts of overall increased capacity on I-25. This capacity could be achieved through either the implementation of managed lanes and/or the implementation of general-purpose lanes. For the purpose of the PEL Study, it was decided to model a managed lanes configuration instead of a general-purpose lanes configuration using the microsimulation model because (1) this configuration is consistent with the recommendations made in the *Express Lanes Master Plan* (CDOT/HPTE, 2020), and (2) this configuration is most consistent with current CDOT policy and highway trends in Colorado. Additional discussion about the potential ramifications of this decision is included in Attachment C, *Traffic and Safety Technical Report*.

The specific layout evaluated in this alternative also only includes the addition of a single travel lane in each direction. Although it is possible that more than one lane could be added to I-25, it was decided to evaluate only a single additional lane due to the identified space constraints within the corridor. This decision and its potential impacts to the overall outcomes of the PEL were evaluated using the DRCOG regional Travel Demand Model. The results and discussion of this analysis is document in the *I-25 Central Traffic Forecasting Technical Memorandum,* which is included in Attachment A, *Existing Conditions Assessment Report*.

Figure 24 and Figure 25 provide an overview of this alternative.

Figure 24 Managed Lanes Alternative

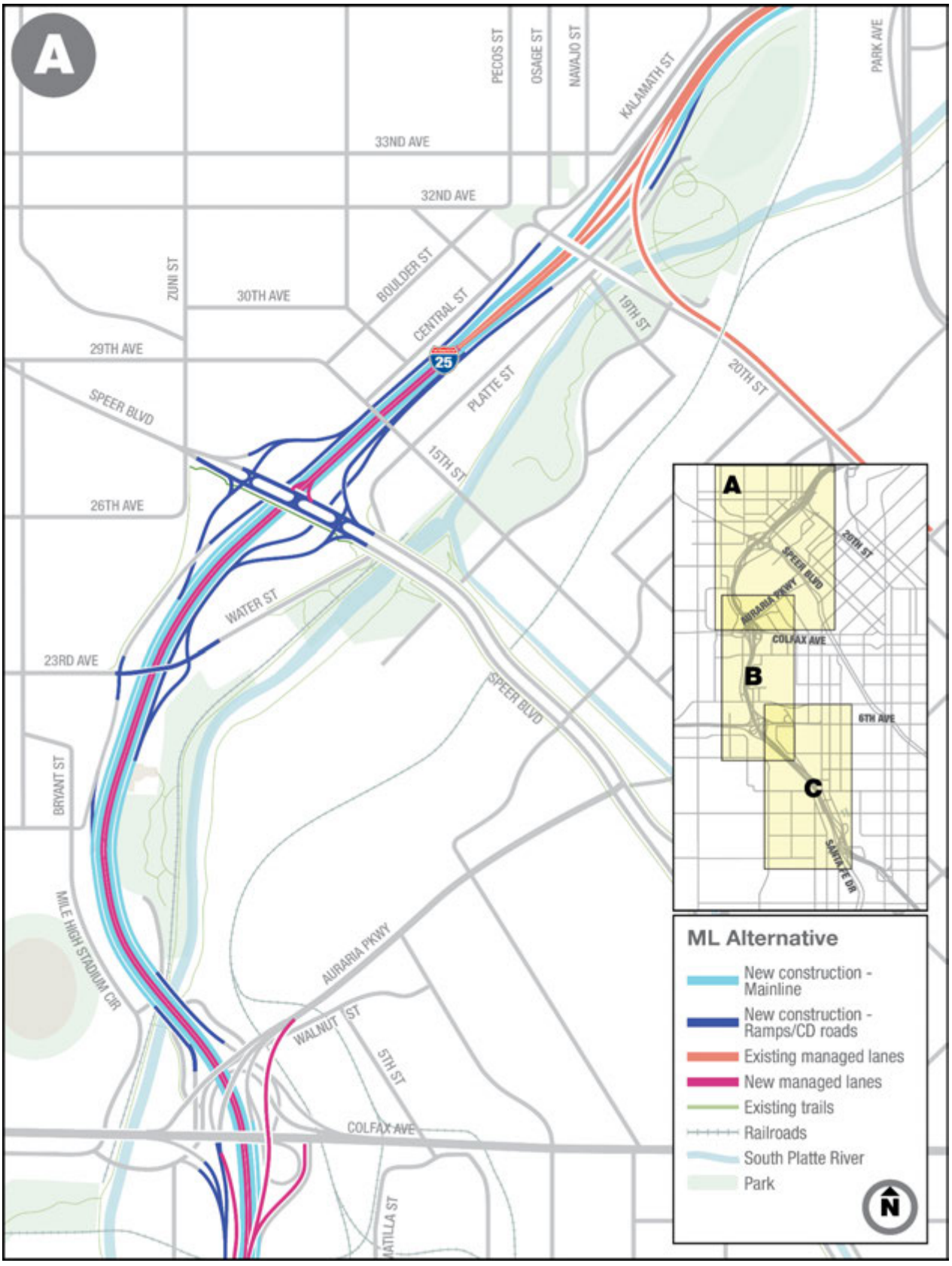
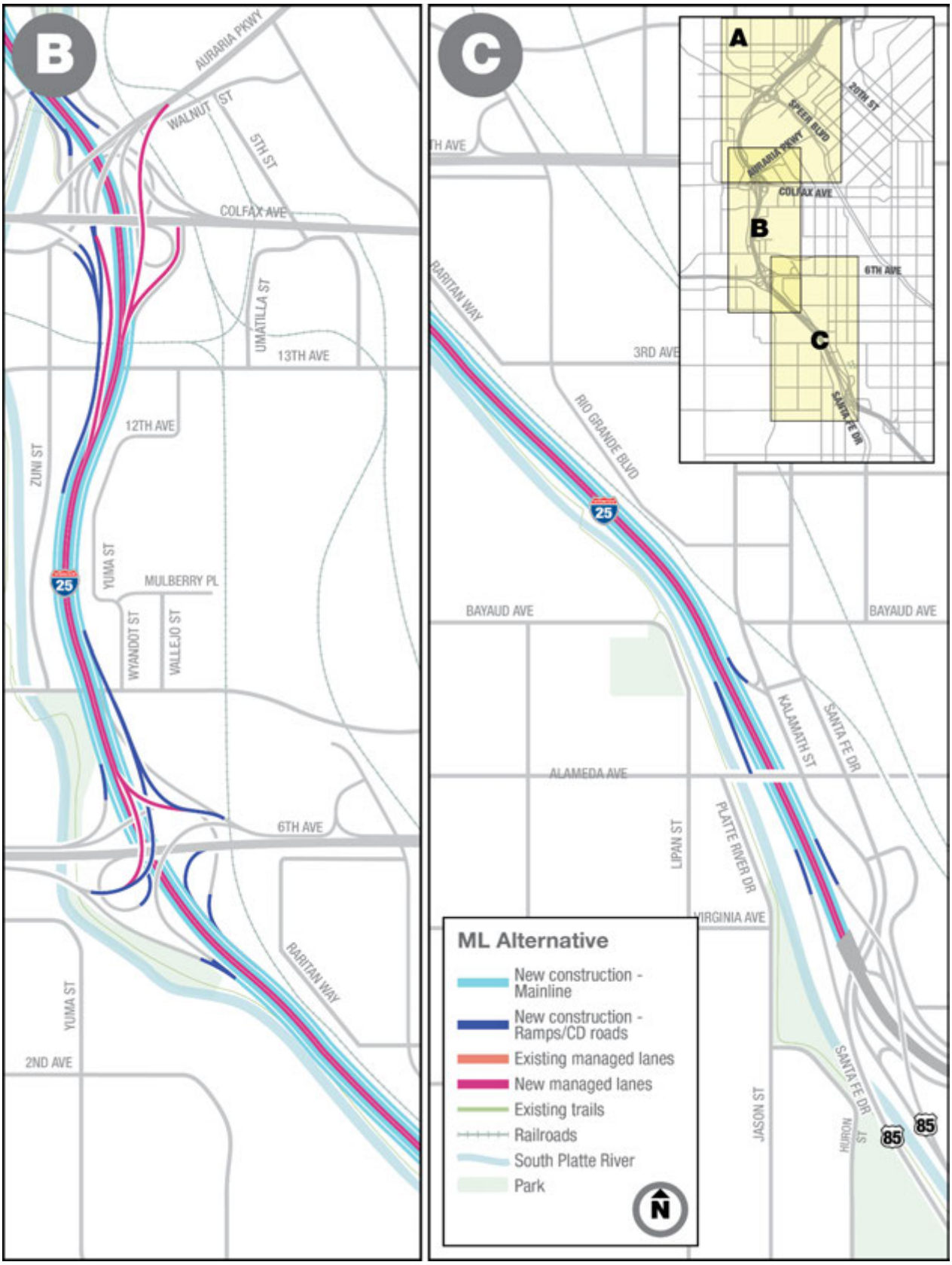


Figure 25 Managed Lanes Alternative (Continued)



Other Alternatives and Elements Carried Forward

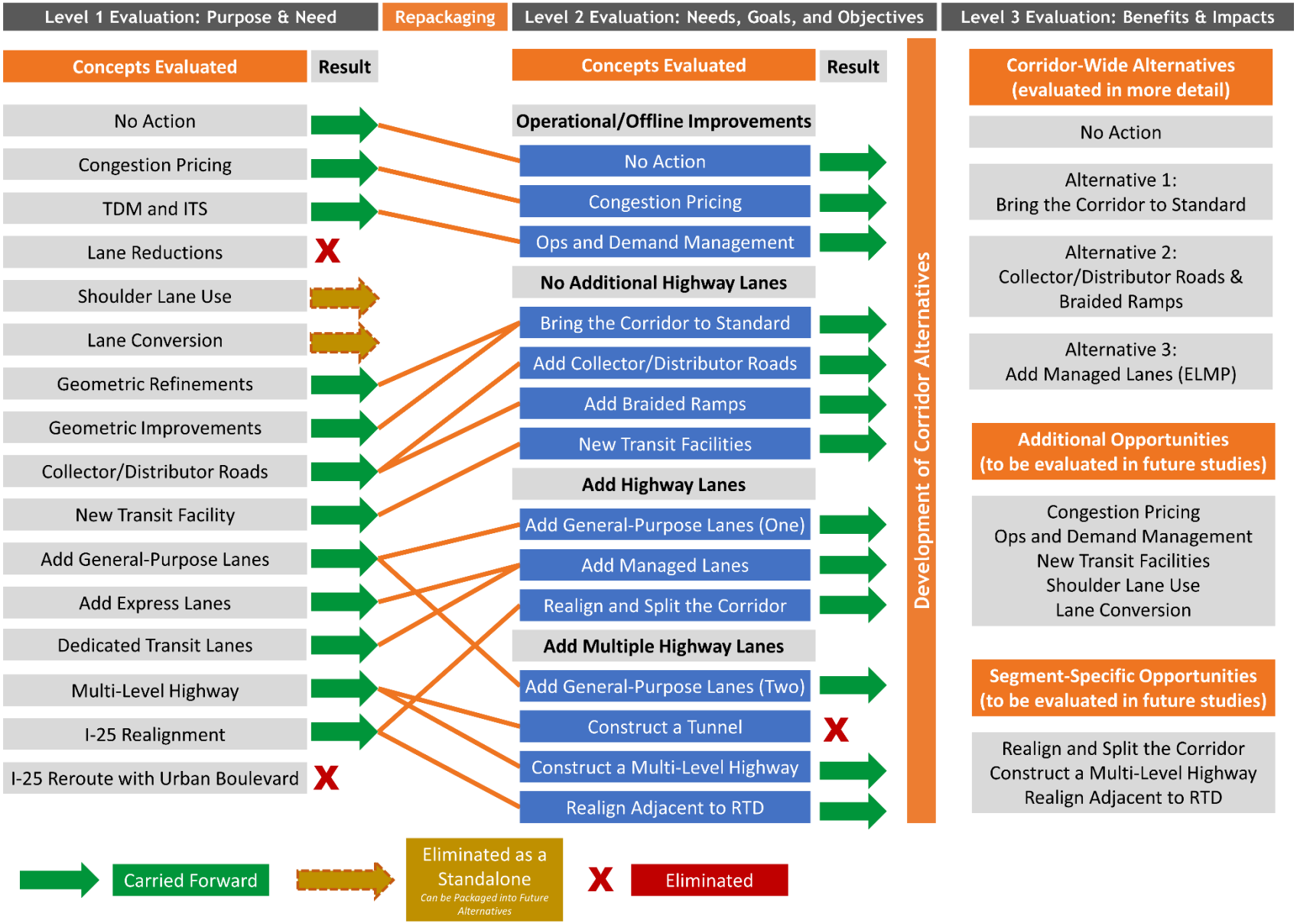
Note that the alternatives identified were created to evaluate a wide range of potential improvement options. Elements of these alternatives could and should be mixed and matched together in future, more-detailed studies to identify specific improvement configurations at particular locations.

Furthermore, not all elements carried forward from the Level 2 evaluation process were able to be evaluated in more detail in Level 3. Some of those improvements—such as Transportation Demand Management (TDM) and Intelligent Transportation Systems (ITS) upgrades—should be applied to all build alternatives regardless of their configuration. Additionally, some improvements—such as congestion pricing—could be implemented in many ways, each of which would have a different outcome. The variability and uncertainty for these types of improvements means that analyzing them in any detail in this type of study likely would not result in any meaningful outcomes.

These types of improvements, which were not evaluated further in the PEL Study, are recommended to be carried forward and evaluated in future studies. For many of these improvements, this means future NEPA studies; however, some of the larger-scale policy decisions should be evaluated in their own study outside of project-specific studies.

Figure 26 summarizes the concepts and alternatives studied within each level of the evaluation process.

Figure 26 Concepts and Alternatives Studied at Each Level of Evaluation



Level 3 Evaluation

The Level 3 evaluation represented the final, most-detailed round of analysis and focused on understanding the specific benefits and trade-offs different improvement options may have. This analysis focused on four major areas: traffic operations, safety, cross connectivity, and impacts.

Traffic Operations

> *Additional information on the Level 3 evaluation for traffic operations analysis is provided in Attachment C,* ***Traffic and Safety Technical Report****.*

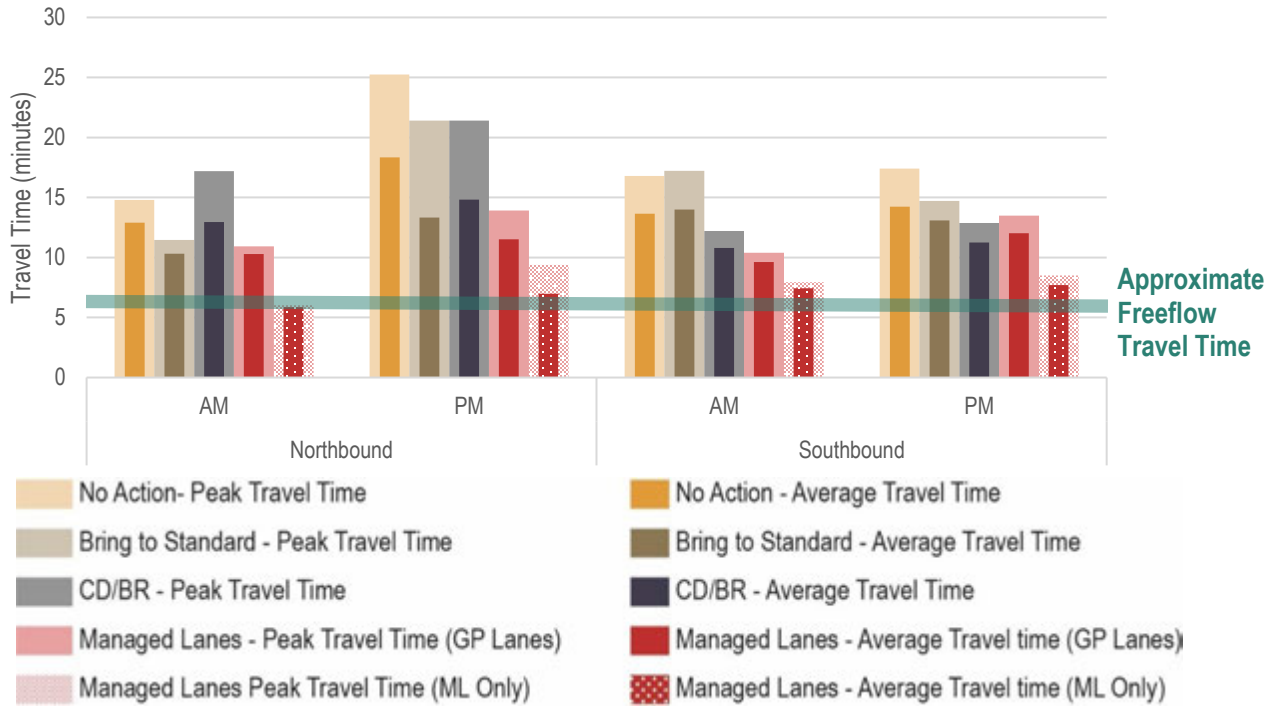
The traffic analysis for the I-25 Central PEL was conducted using a combination of travel demand modeling and microsimulation traffic analysis. Typically, this analysis would be completed using the most currently available forecasted travel demand, which in this case would be a planning horizon year of 2040. By 2040, the travel demand for the I-25 Central traffic analysis area is projected to increase by approximately 20 percent. However, existing conditions within the traffic analysis area already include significant congestion. Although planned improvements to the transportation network were included in the 2040 No Action Alternative model, the model cannot process the forecasted future travel demand. The network within the microsimulation traffic model experiences significant queue spillbacks that prevent the model from fully evaluating the evening peak period.

To analyze the potential benefits of the alternatives, the project team—with input and concurrence from FHWA and Denver—agreed that overall travel demand should be reduced to a point at which the microsimulation traffic model could produce reasonable results without grid-locking. Based on an iterative testing process, a global 10 percent travel demand reduction was applied to the entire microsimulation model. This reduction allowed the model to be used for the comparative analysis, while still showing the overall growth trends. Additional discussion about the travel demand reduction is included in Attachment C, *Traffic and Safety Technical Report*.

With this demand reduction, the conditions analyzed in the PEL Study reflect a planning horizon year of approximately 2030. This section summarizes the outcomes of this detailed traffic analysis using this planning horizon year.

One way to measure the overall congestion relief benefits of each alternative is to examine the expected travel times on I-25. In general, the closer an alternative's travel time is to the free flow travel time—which is about seven minutes between Broadway and Park Avenue—the less congestion there is. Based on this indicator, the traffic analysis results show that the Managed Lanes Alternative would have the lowest travel times followed by the Collector/Distributor Roads and Braided Ramps Alternative, then the Bring the Corridor to Standard Alternative, and finally the No Action Alternative. Figure 27 summarizes the end-to-end travel times on I-25 from Broadway to Park Avenue.

Figure 27 Travel Times from Broadway to Park Avenue

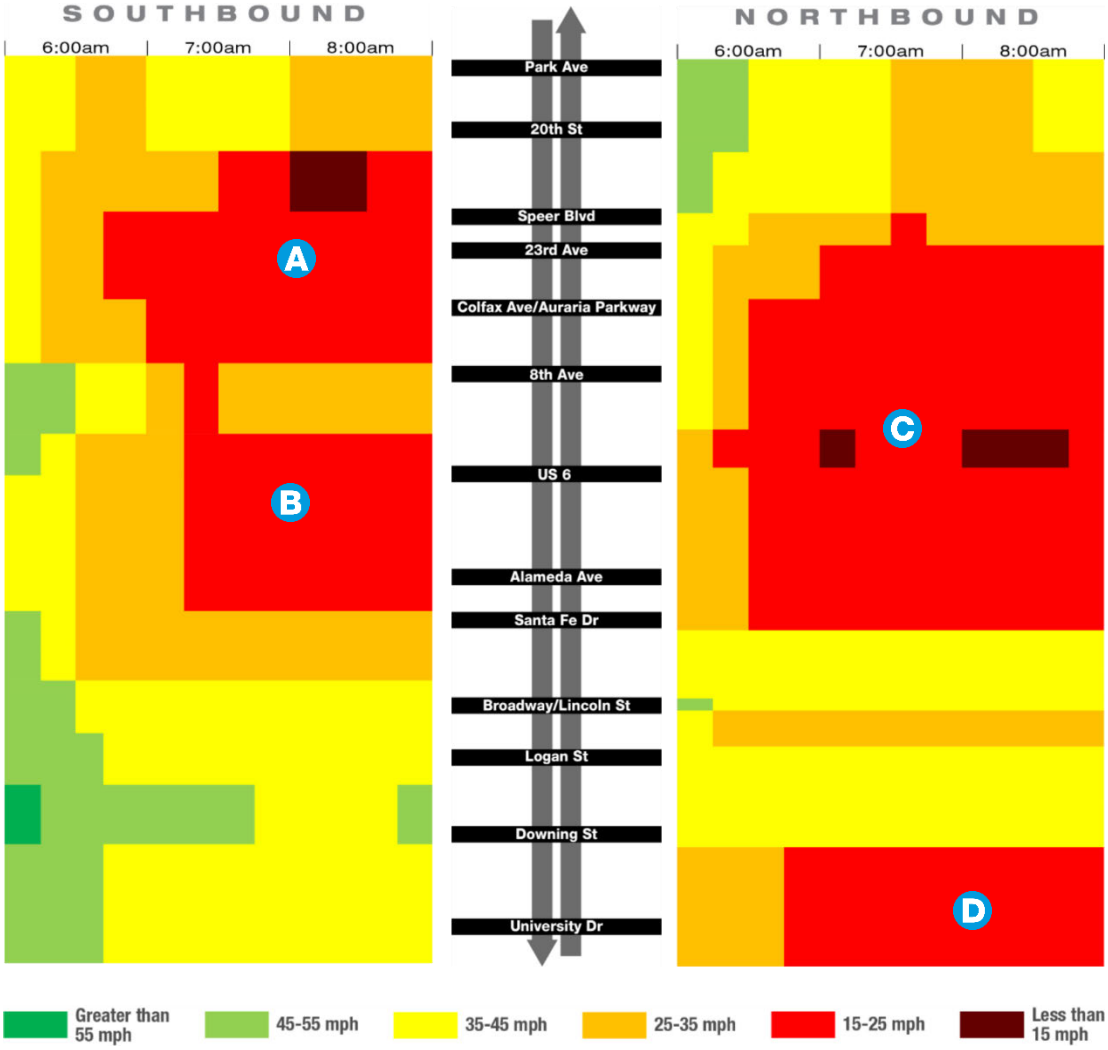


Notes: "CD/BR" = Collector/Distributor Roads and Braided Ramps Alternative, "GP" = general-purpose lane, "ML" = managed lane
Source: Travel time information was obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Note that the traffic analysis results presented in this chapter represent an area larger than the defined PEL study limits. This was done to ensure that operational changes that result from proposed improvements near the edges of the PEL study limits—such as ramp improvements at Santa Fe Drive/US 85 and at 20th Street—are fully captured in the traffic analysis results. Additional information about the size of the traffic analysis area and more-detailed traffic analysis results are presented in Attachment C, *Traffic and Safety Technical Report*.

In addition to examining the total travel times, alternatives were evaluated on travel speed. Examining the average speed at specific locations along the corridor across the peak periods for each alternative provides an understanding of which parts of the alternative perform best and which parts of the alternative do not provide as much benefit. Figure 28 through Figure 35 show annotated heat diagrams depicting and describing the average speeds on I-25 for each alternative based on the microsimulation traffic analysis results.

Figure 28 No Action Alternative Average, AM Peak Period Speeds



A Five lanes of traffic north of 20th Street, plus the existing managed lane must merge into four lanes of traffic underneath Colfax Avenue. This creates a bottleneck and causes traffic to slow.

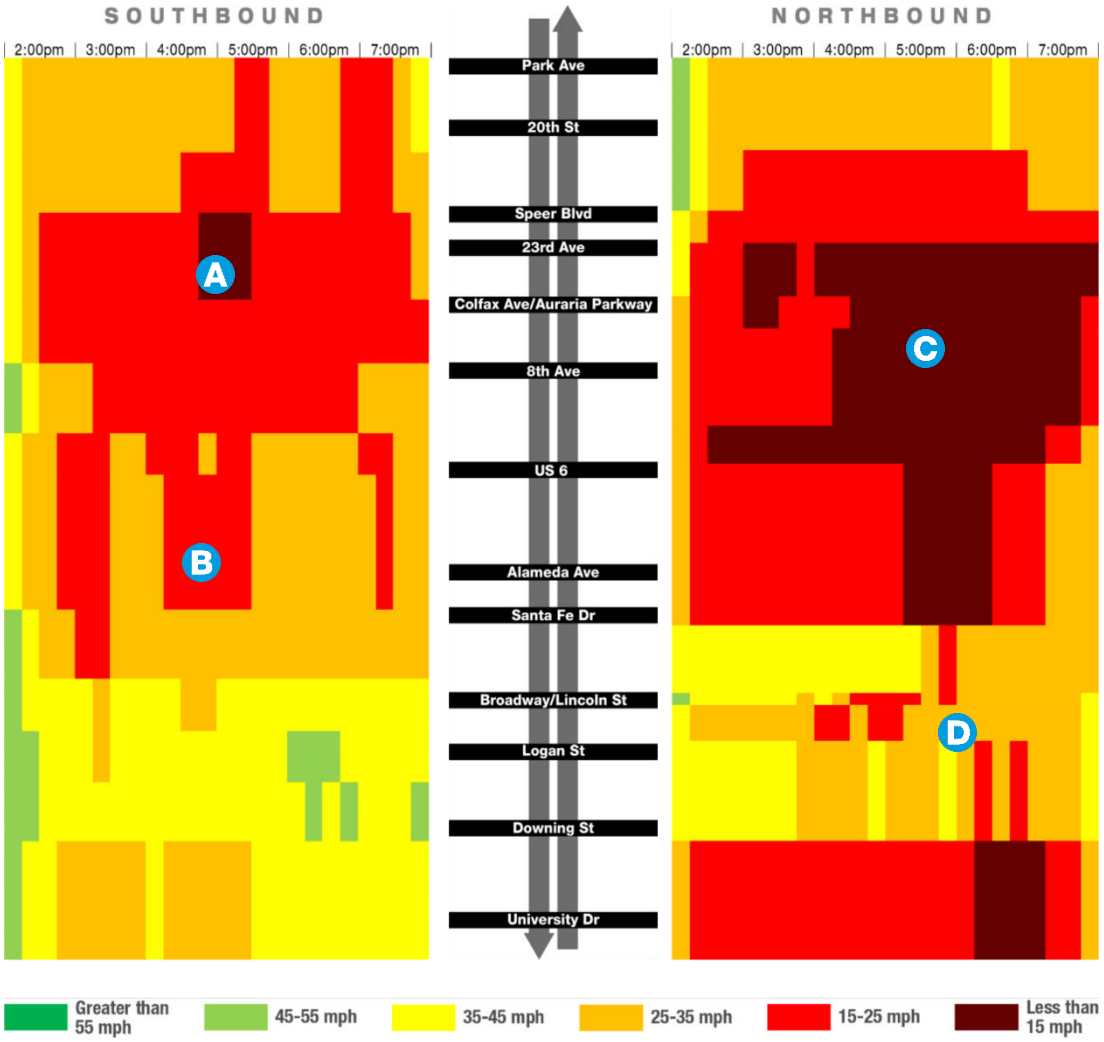
B Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting I-25 to Alameda Avenue and Santa Fe Drive/US 85. This lane changing causes traffic to slow.

C Without improvements, northbound I-25 is anticipated to have continuous stop-and-go traffic beginning at Santa Fe Drive/US 85 and continuing to approximately Speer Boulevard due to high mainline and ramp volumes.

D Traffic coming northbound on I-25 into the I-25 Central corridor from south of the I-25 Central corridor is metered/constrained due to existing capacity limitations between University Boulevard and Downing Street.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 29 No Action Alternative Average, PM Peak Period Speeds



A Five lanes of traffic north of 20th Street must merge into four lanes of traffic underneath Colfax Avenue. This creates a bottleneck and causes traffic to slow.

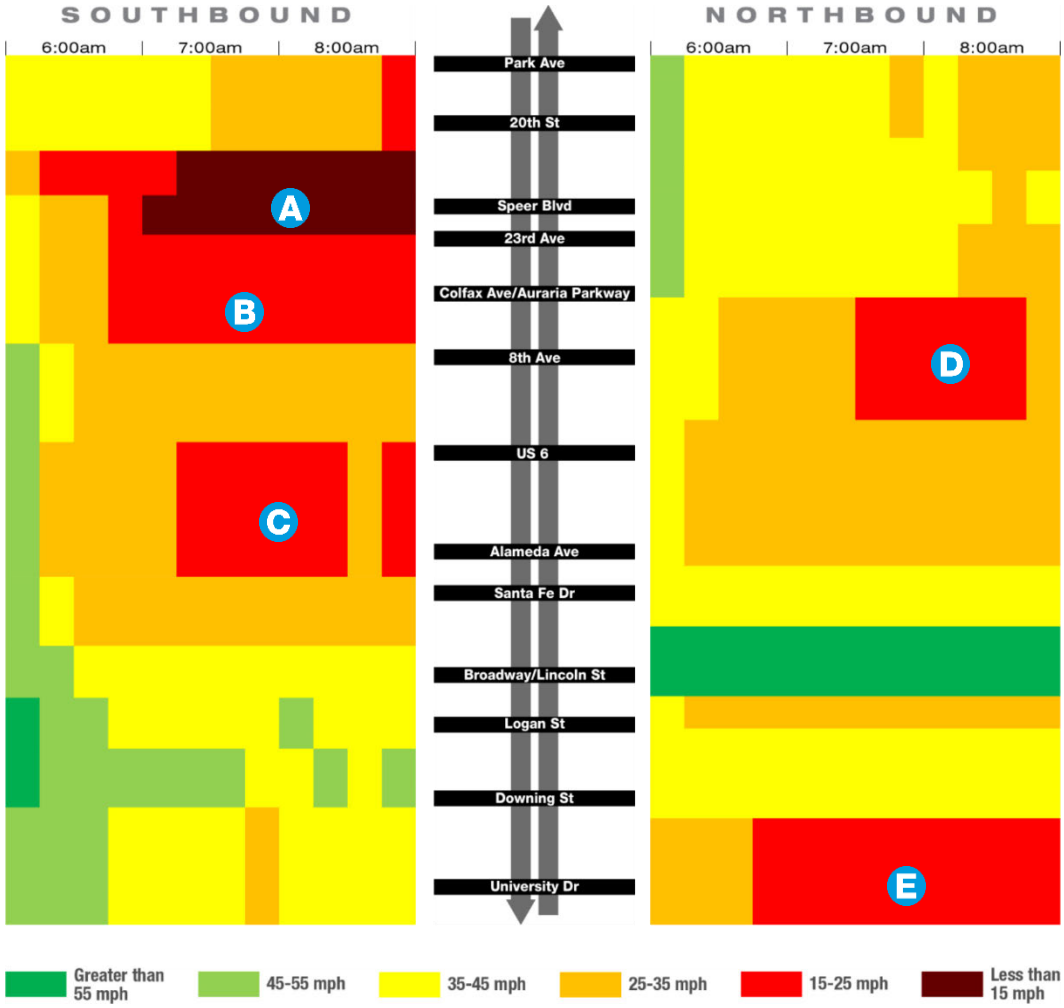
B Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting I-25 to Alameda Avenue to Santa Fe Drive/US 85. This lane changing causes traffic to slow.

C Without improvements, northbound I-25 is anticipated to have continuous stop-and-go traffic beginning at Santa Fe Drive/US 85 and continuing to approximately Speer Boulevard due to high mainline and ramp volumes.

D Spillback congestion from the area between Santa Fe Drive/US 85 to Colfax Avenue/Auraria Parkway is limited due to the metering effects south of the I-25 Central corridor. Capacity limitations on northbound I-25 near University Boulevard result in fewer vehicles being able to reach the I-25 Central corridor. This limits the length of queues within the I-25 Central corridor.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 30 Bring the Corridor to Standard Alternative, AM Peak Period Average Speeds



A Moderate to heavy traffic volumes coming onto I-25 from 20th Street and Speer Boulevard must weave across traffic exiting to Speer Boulevard and Colfax Avenue and merge with traffic exiting from the existing managed lane. This causes the freeway to slow.

B Five lanes of traffic north of 20th Street must merge into four lanes of traffic underneath Colfax Avenue. This creates a bottleneck and causes traffic to slow.

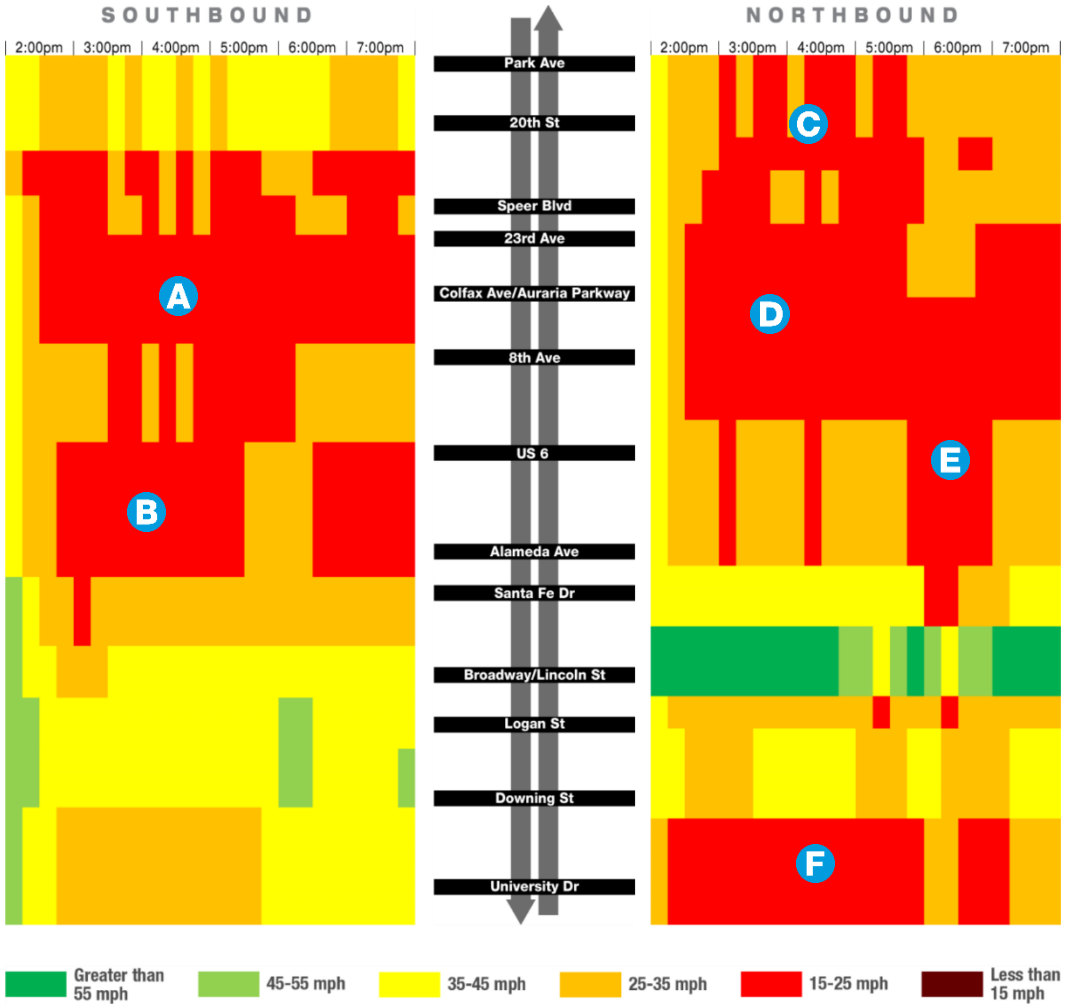
C Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting I-25 to Alameda Avenue and Santa Fe Drive/US 85. This lane changing causes traffic to slow.

D Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting to Colfax Avenue and Auraria Parkway. This lane changing causes traffic to slow.

E Traffic coming northbound on I-25 into the I-25 Central corridor from south of the I-25 Central corridor is metered/constrained due to existing capacity limitations between University Boulevard and Downing Street.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 31 Bring the Corridor to Standard Alternative, PM Peak Period Average Speeds



A Five lanes of traffic north of 20th Street must merge into four lanes of traffic underneath Colfax Avenue. This creates a bottleneck and causes traffic to slow.

B Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting I-25 to Alameda Avenue and Santa Fe Drive/US 85. This lane changing causes traffic to slow.

C Improving the flow through the I-25 Central corridor pushes more vehicles into the I-70 and I-25 interchange. This results in a slowdown to the north of the I-25 Central corridor.

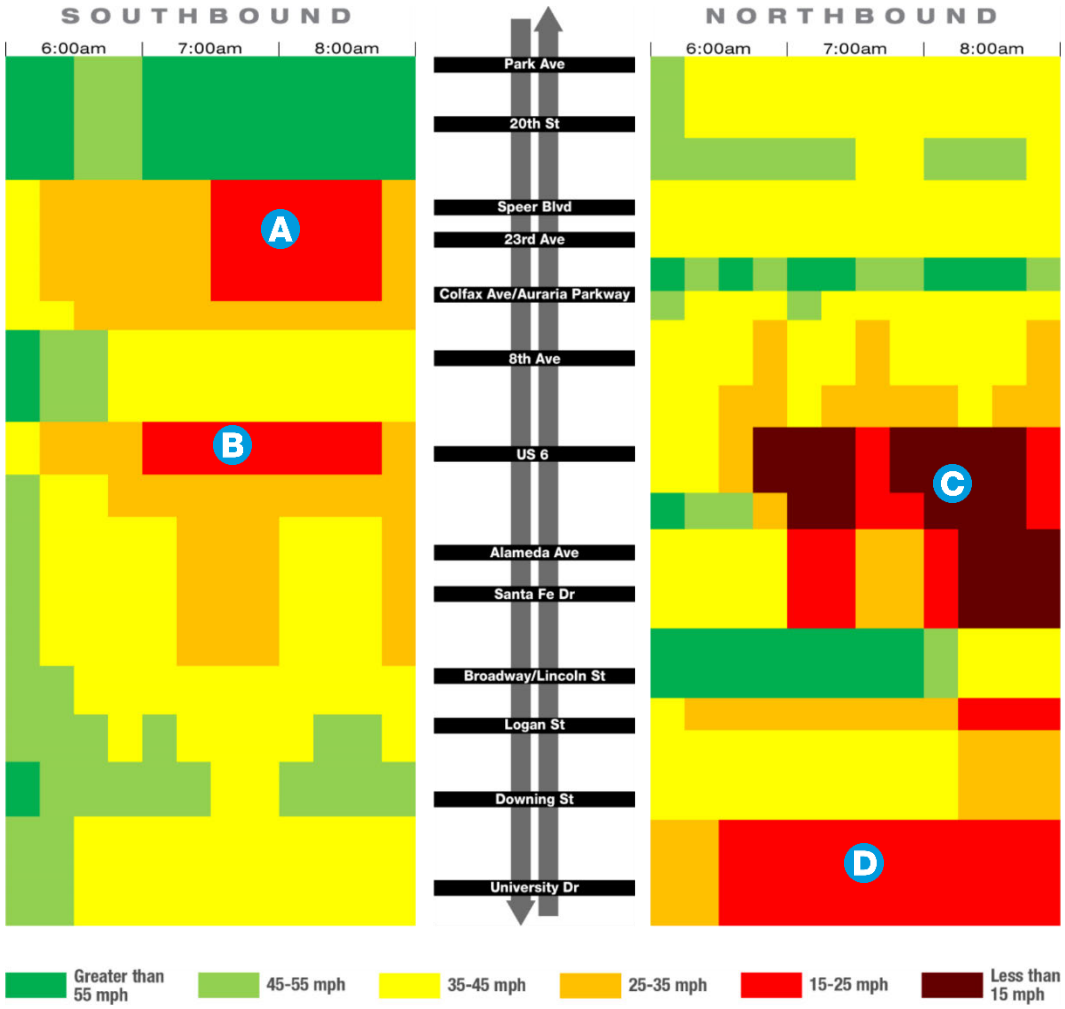
D High northbound on-ramp volumes from US 6/6th Avenue to Speer Boulevard result in slow traffic.

E Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting to Colfax Avenue and Auraria Parkway. This causes traffic to slow.

F Traffic coming northbound on I-25 into the I-25 Central corridor from south of the I-25 Central corridor is metered/constrained due to existing capacity limitations between University Boulevard and Downing Street.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 32 Collector/Distributor Roads and Braided Ramps Alternative, AM Peak Period Average Speeds



A The large volume of southbound I-25 traffic exiting to Colfax Avenue, 8th Avenue, and US 6/6th Avenue must merge to the right to access the collector/distributor road. Shortly after the collector/distributor road exit, on-ramp traffic from 20th Street, Speer Boulevard, 23rd Avenue, and 17th Avenue must merge into the mainline. These two movements result in a slowdown in southbound traffic.

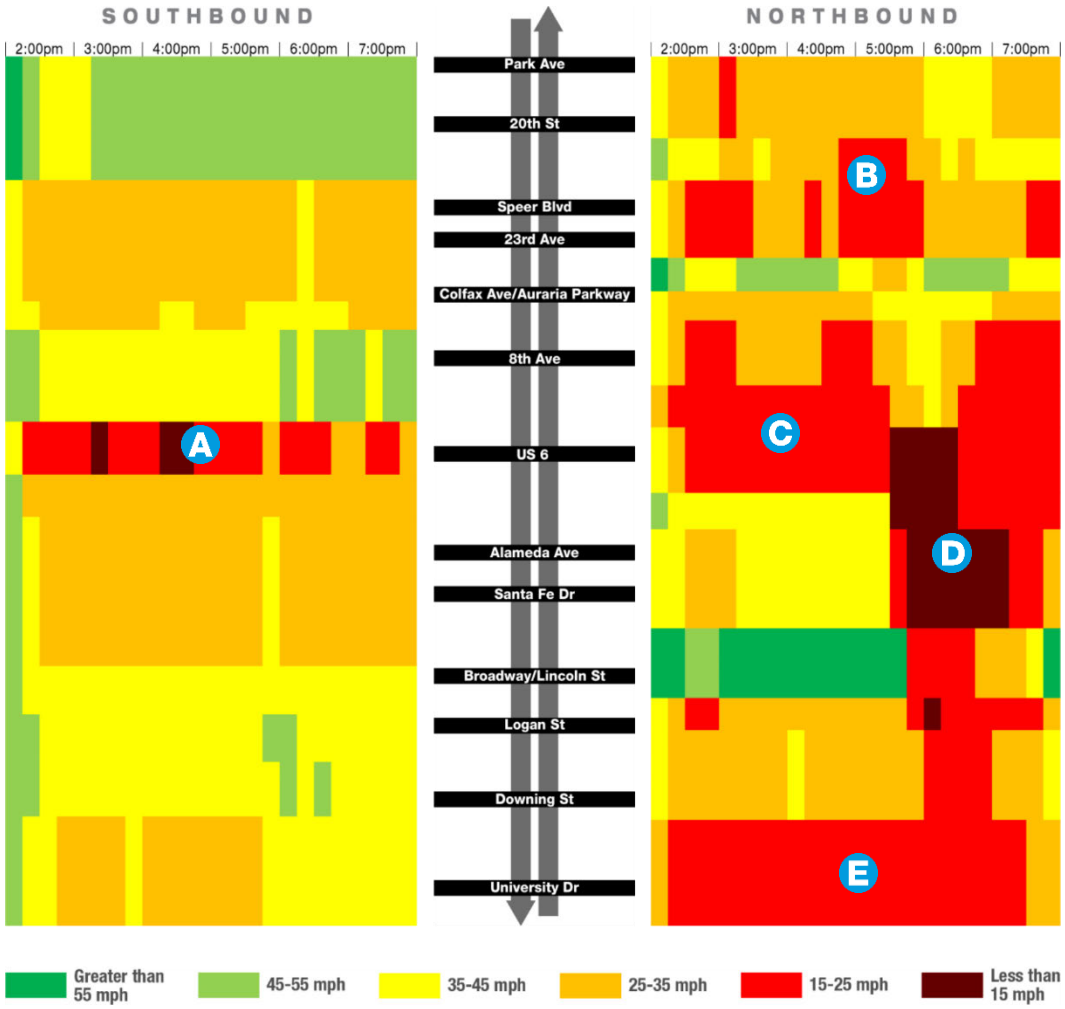
B Traffic coming onto I-25 from Colfax Avenue and Auraria Parkway must change lanes across traffic exiting to the Alameda Avenue and Santa Fe Drive/US 85 collector/distributor road. This causes traffic to slow.

C One lane of traffic exits to the 8th Avenue, Colfax Avenue, and Auraria Parkway collector/distributor road resulting in three lanes of traffic on the mainline freeway for a short section until the US 6/6th Avenue on-ramp comes on as an additional lane. This three-lane cross section creates a bottleneck and results in the slowing of traffic.

D Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the corridor.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 33 Collector/Distributor Roads and Braided Ramps Alternative, PM Peak Period Average Speeds



A Traffic coming onto I-25 from Colfax Avenue and Auraria Parkway must change lanes across traffic exiting to the Alameda Avenue and Santa Fe Drive/US 85 collector/distributor road. This causes traffic to slow.

B High on-ramp volumes from Speer Boulevard merging with high mainline volumes meet and/or exceed the capacity of the mainline freeway resulting in vehicles slowing.

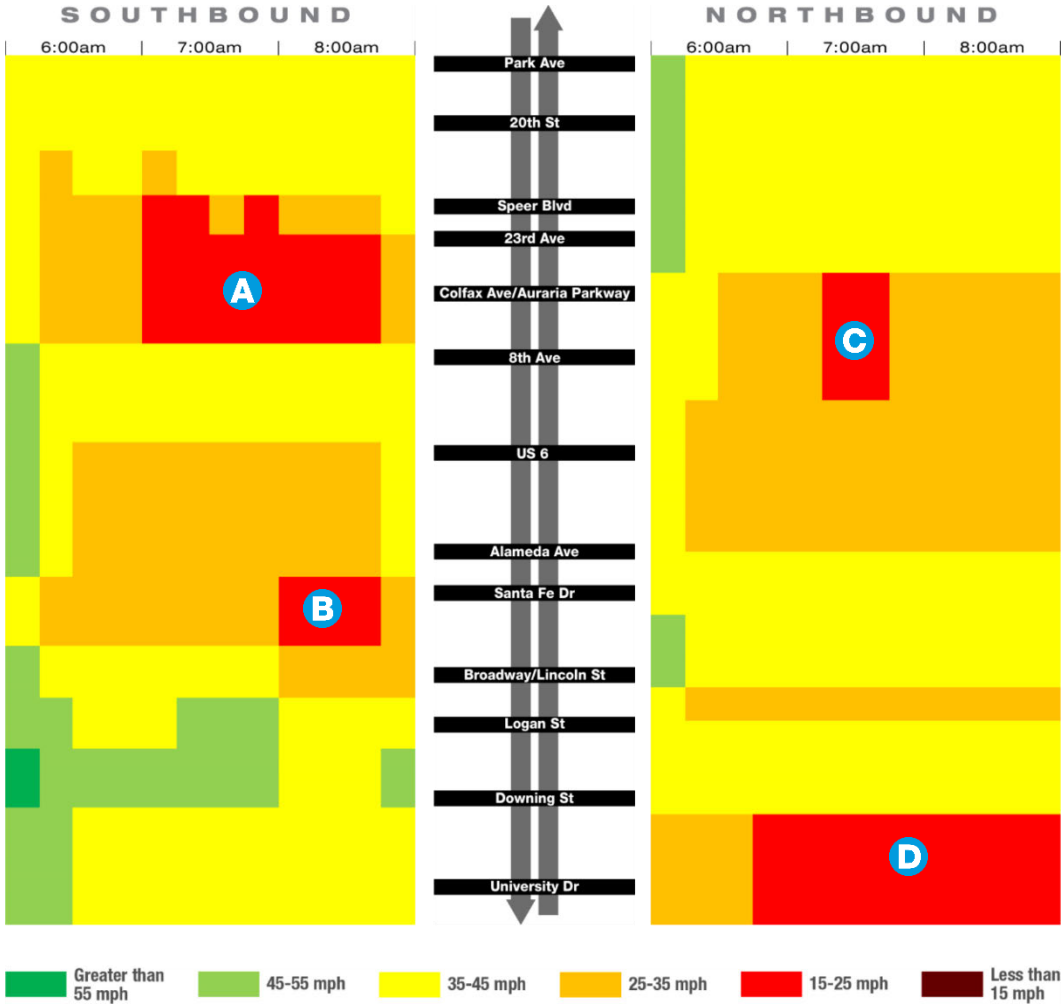
C Heavy on-ramp volumes from US 6/6th Avenue cause the freeway to slow.

D One lane of traffic exits to the 8th Avenue, Colfax Avenue, and Auraria Parkway collector/distributor road resulting in three lanes of traffic on the mainline freeway for a short section until the US 6/6th Avenue on-ramp comes on as an additional lane. This three-lane cross section creates a bottleneck and results in the slowing of traffic.

E Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the corridor.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 34 Managed Lanes Alternative, AM Peak Period Average Speeds



Note: Speeds depicted in this diagram only represent speeds in the general-purpose lanes.

A Five general-purpose lanes of traffic north of 20th Street must merge into four lanes of traffic underneath Colfax Avenue. This creates a bottleneck and causes traffic to slow.

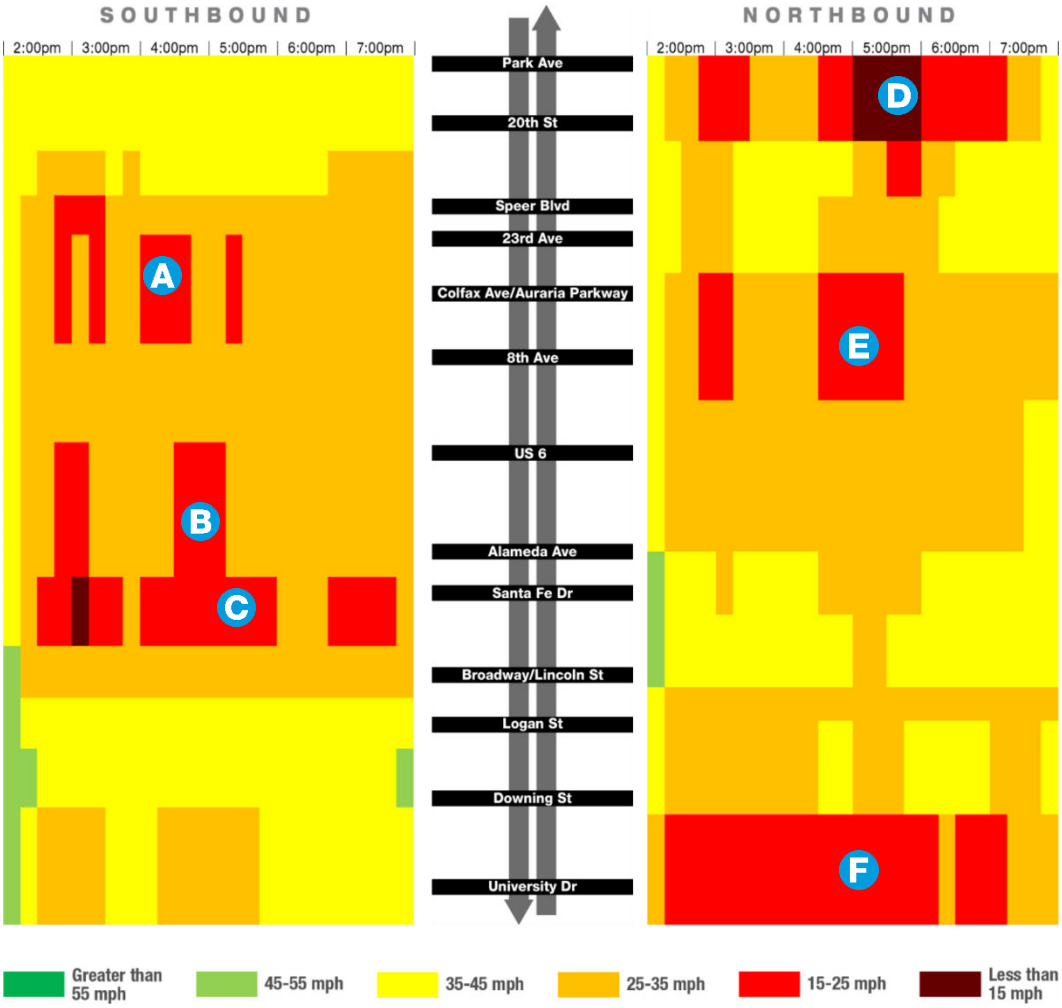
B The new southbound managed lane ends near Santa Fe Drive/US 85 and the traffic in the managed lane must merge back into the four general-purpose lanes. This lane reduction causes traffic to slow.

C Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting to Colfax Avenue and Auraria Parkway. This causes traffic to slow.

D Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the corridor.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Figure 35 Managed Lanes Alternative, PM Peak Period Average Speeds



Note: Speeds depicted in this diagram only represent speeds in the general-purpose lanes.

A Five general-purpose lanes of traffic north of 20th Street must merge into four lanes of traffic underneath Colfax Avenue. This creates a bottleneck and causes traffic to slow.

B Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting I-25 to Alameda Avenue and Santa Fe Drive/US 85. This lane changing causes traffic to slow.

C Where the southbound managed lane ends near Santa Fe Drive/US 85, the traffic in the managed lane must merge back into the four general-purpose lanes. This lane-reduction causes traffic to slow.

D Improving the flow through the I-25 Central corridor pushes more vehicles into the I-70 and I-25 interchange. This results in a slowdown to the north of the I-25 Central corridor.

E Traffic coming onto I-25 from US 6/6th Avenue must change lanes across traffic exiting to Colfax Avenue and Auraria Parkway. This causes traffic to slow.

F Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the corridor.

Source: Speed data were obtained from the I-25 Central PEL microsimulation traffic models. Additional information about these data can be found in Attachment C, Traffic and Safety Technical Report.

Local Network Analysis

*Additional information about the methodology used to perform the local network analysis and more detailed results can be found in Attachment C, **Traffic and Safety Technical Report**.*

I-25 Central is located in a dense urban environment in which the freeway and the local roadway network work together to serve travel demand. In some locations, the local roadway network provides alternate routes for travelers on I-25, which helps alleviate some congestion on the freeway. However, in other locations, barriers within the I-25 Central corridor—such as the South Platte River, the railroads, and I-25 itself—bisect and fragment the local roadway network. This fragmented local roadway network results in some drivers using I-25 for short trips because it provides the most continuous/direct connection over, under, or around these barriers.

To understand how improvements may affect the local roadway network, the macrosimulation traffic model was used to evaluate volumes at certain locations throughout the traffic analysis area. This analysis showed that when more capacity is available on I-25 during the peak travel periods, less traffic diverts to the local roadway network. In general, the improvements provided in the three build alternatives allow I-25 to process between approximately 8 percent and 13 percent more vehicles during the peak periods as compared to the 2030 No Action Alternative. This increase in serviced vehicles on I-25 results in an overall decrease in traffic on the local roadway network. A summary of this analysis is shown in Table 10.

Table 10 Traffic Impact on Local Network

Alternative	Key Considerations
No Action	No improvements
Bring the Corridor to Standard	Pulls some traffic from the local network to I-25
Collector/Distributor Roads and Braided Ramps	Pulls a large amount of traffic from the local network to I-25 (collector/distributor roads facilitate short, local trips)
Managed Lanes	Pulls some traffic from the local network to I-25

Safety Analysis

The safety analysis performed on each Level 3 alternative was based on the American Association of State Highway and Transportation Officials (AASHTO) *2010 Highway Safety Manual* (HSM) methodology. This methodology uses statistical analysis calibrated to historical conditions to predict the number of crashes on a future roadway facility based on its specific design elements and configuration (AASHTO, 2010).

The 2010 HSM methodology was developed originally for use during the design phase of projects to help decision makers understand the specific safety benefits/trade-offs of detailed design elements, such as safety trade-offs for different shoulder widths in space constrained areas. The HSM was intended to help designers decide, from a safety perspective, if decisions made during the design process would impact safety of a roadway. This detailed trade-off analysis, although very useful in the design phase of a project, does not perfectly reflect the high-level planning nature of the alternatives evaluated in the PEL Study. The alternatives evaluated at this level of study are conceptual in nature and, therefore, most of the details that the HSM analyzes are neither well defined nor differentiated within or between different alternatives.

The outcomes of the HSM analysis and more information about its methodology and application are presented in Attachment C, *Traffic and Safety Technical Report*. However, a blended approach was used for the overall evaluation of Level 3 alternatives in which the quantitative HSM results guided and informed a qualitative evaluation. The outcome of this approach, presented below, was a discussion about the potential benefits and considerations of the key elements of each alternative.

No Action Alternative

Without improvements, the conditions on I-25 Central are expected to continue to deteriorate between now and 2030. As traffic volumes increase, the total number of crashes also are expected to increase between the existing conditions (approximately 1,000 crashes per year) and future No Action Alternative conditions.

Bring the Corridor to Standard Alternative

The Bring the Corridor to Standard Alternative is predicted to provide an overall reduction in the total number of crashes on I-25 as compared to the No Action Alternative. Key improvements provided in this alternative that contribute to improved safety include:

- Improved roadway geometrics—including more gentle curves and full-width travel lanes—will give drivers more time and space to react to changing roadway conditions
- Improved ramp spacing will reduce the turbulence on the freeway from vehicles merging and weaving, allowing for a more predictable and constant flow of traffic
- Improved and added full-width shoulders will provide space for disabled vehicles to be removed from traffic and allow first responders to assist drivers outside of the active travel lanes

Collector/Distributor Roads and Braided Ramps Alternative

The Collector/Distributor Roads and Braided Ramps Alternative is expected to further reduce the number of crashes as compared to the Bring the Corridor to Standard Alternative. Key improvements provided in this alternative that contribute to improved safety include:

- Improved roadway geometrics—including more gentle curves and full-width travel lanes—will give drivers more time and space to react to changing roadway conditions
- Collector/distributor roads will reduce the turbulence on the mainline freeway from vehicles merging and weaving, allowing for a more predictable and constant flow of traffic
- Collector/distributor roads will provide space away from the mainline freeway to hold off-ramp queues which will prevent these queues from spilling back onto the mainline freeway and posing an unexpected hazard to through-traffic
- Braided ramps will remove the need for vehicles to weave which significantly reduces conflict points on the highway and makes the flow of traffic safer and more predictable
- Improved and added full-width shoulders will provide space for disabled vehicles to be removed from traffic and allow first responders to assist drivers outside of the active travel lanes

Managed Lanes Alternative

The Managed Lanes Alternative is expected to provide some safety benefits to the corridor, while also introducing new safety elements to consider. Key elements provided in this alternative that contribute to improved safety include:

- Improved roadway geometrics—including more gentle curves and full-width travel lanes—will give drivers more time and space to react to changing roadway conditions

- Improved ramp spacing will reduce the turbulence on the freeway from vehicles merging and weaving, allowing for a more predictable and constant flow of traffic
- Improved and added full-width shoulders will provide space for disabled vehicles to be removed from traffic and allow first responders to assist drivers outside of the active travel lanes
- Separating the through/regional traffic from the local traffic entering and/or exiting the freeway will reduce weaving between travel lanes

In addition to providing benefits to safety, the addition of managed lanes in this alternative also may introduce new safety concerns. These concerns primarily extend from the differential in speeds expected to occur between the general-purpose lanes and the managed lanes. Because the managed lanes are expected to be separated from the general-purpose lanes only via painted stripes, these speed differentials have the potential to result in additional crashes as some drivers attempt to merge into or out of the managed lanes. Based on observations made about other managed lane facilities already in operation across Colorado, this merging behavior is likely to occur both at designated managed lane ingress and egress locations and, due to lane-changing violations, at locations where ingress and egress is prohibited.

At this time, there is limited historical safety information available about managed lane facilities. Furthermore, the safety calculations are based on assumptions of detailed design considerations—such as the width of the buffer space provided between the general-purpose lanes and the managed lanes, or the design of managed lane ingress and egress locations. Because of these factors, the impact of managed lanes on the overall safety of the corridor is not well known. Future studies should reassess the safety of the managed lanes when more-detailed design information is available.

Multimodal Connectivity Analysis

As part of the alternatives evaluation process, the PEL Study considered the existing and potential future crossing needs of I-25. This included crossings for all modes of travel, such as bicycles, pedestrians, transit vehicles, and cars. Evaluation of these crossings was completed through a collaborative effort between the PEL study team and representatives from Denver.

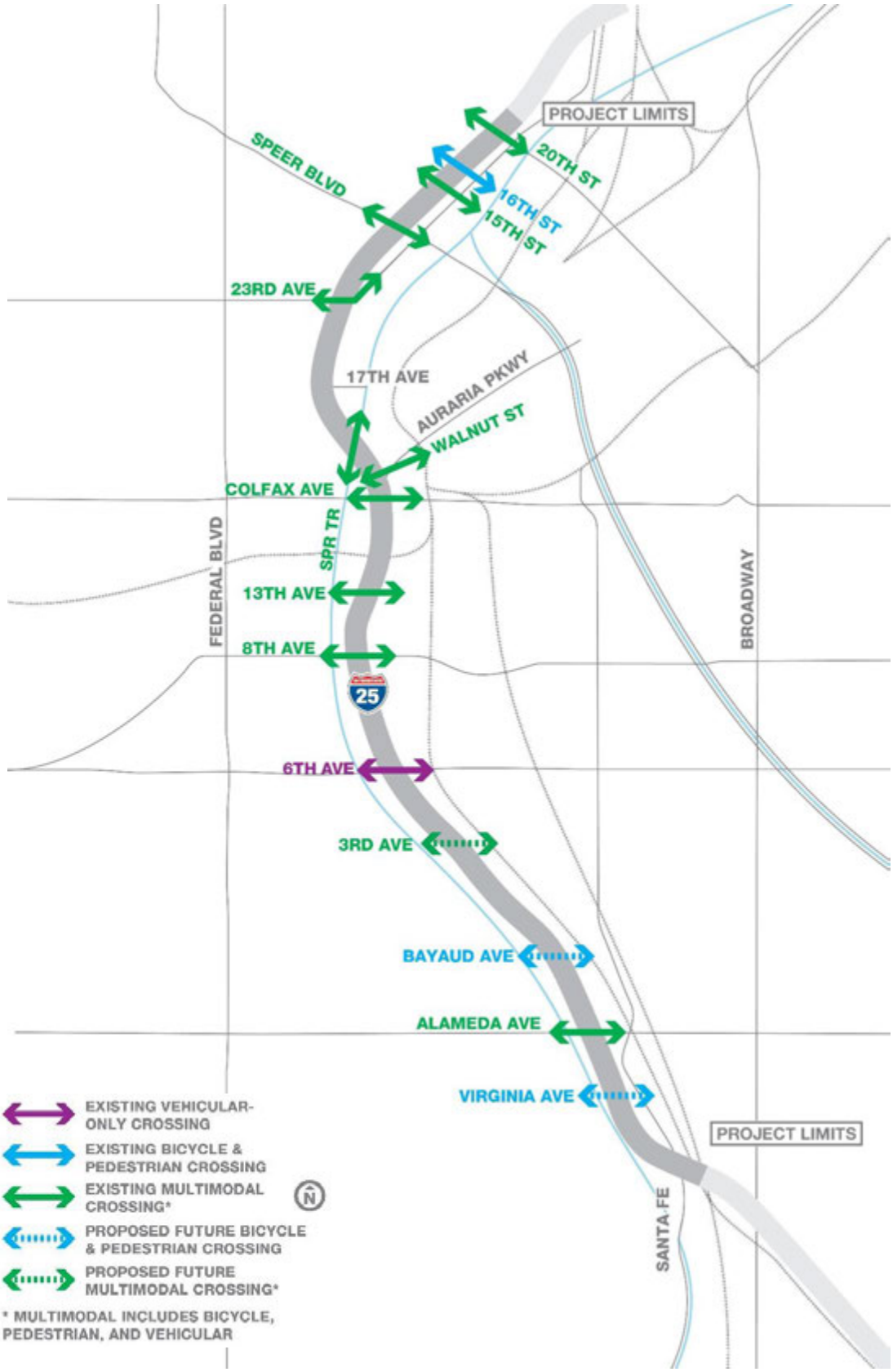
*The identification of locations/areas where additional crossings are needed was completed using information gathered in the **Existing Conditions Assessment Report** (Attachment A), the **Valley Highway EIS** (November 2006), and **Denver Moves: Pedestrians & Trails** (January 2019).*

The evaluation process used for crossings of I-25 was completed in two parts. The first part focused on identifying the general locations/areas where crossings are needed. This also included identifying the type of crossing needed in each area—such as bicycle and pedestrian only versus a crossing that accommodates all modes of travel. The second part of the evaluation focused on identifying considerations that should be applied to all future studies and projects. Figure 36 summarizes the existing and potential future crossings identified through the analysis.

At the PEL level of study, not enough details are known to identify the exact location of each crossing. However, through the collaborative evaluation effort, key considerations were identified that should inform future, more-detailed studies and projects, including:

- Efforts should be made to reduce the crossing distance for pedestrians and bicyclists
- Where crossings accommodate vehicle and non-vehicle movements and/or where crossings may cross entrance and exit ramps to/from I-25, future studies and projects should focus on providing safe and comfortable places for non-vehicular traffic to travel next to and cross vehicle traffic

Figure 36 Existing and Potential Future Crossings of I-25



Impacts Analysis

In addition to evaluating the benefits of potential improvements, the PEL Study examined the level of potential impacts each alternative may have to the surrounding environment. To accomplish this at this level of study, impacts were measured by the amount of land (ROW) that would be required to implement the alternative. Based on this analysis, the Collector/Distributor Roads and Braided Ramps Alternative would have the most impact, followed by the Managed Lanes Alternative, then the Bring the Corridor to Standard Alternative, and finally the No Action Alternative, which would have the least impact. Table 11 summarizes the level of impact by alternative.

Table 11 Level of Impact by Alterative

Alternative	Level of Impact
No Action	No Impact
Bring the Corridor to Standard	Least Impact (10 acres to 15 acres)
Collector/Distributor Roads and Braided Ramps	Most Impact (35 acres to 45 acres)
Managed Lanes	More Impact (30 acres to 40 acres)

** Level of impact was determined using conceptual level of design for reference only*

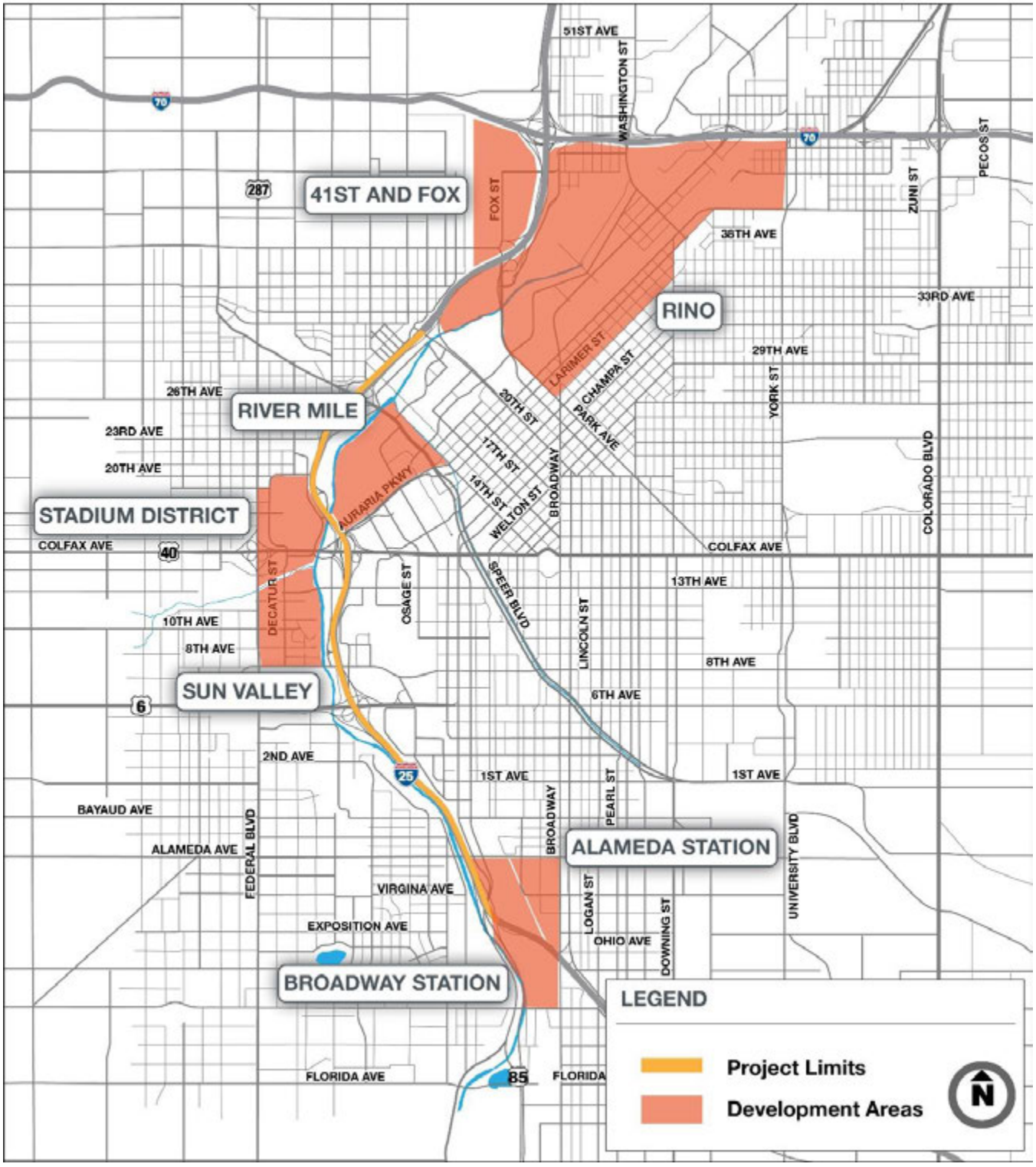
What other elements were considered during the evaluation process?

Through the process of completing this study, stakeholders identified a few key questions regarding additional considerations that were not captured within the existing three-level evaluation process. To answer these questions, the project team completed three sensitivity analyses. The purpose of these sensitivity analyses was to provide insight into potential future scenarios that are different from those used to evaluate the alternatives. By understanding how these different potential future scenarios could change the benefits and impacts of alternatives, this PEL Study could recommend additional actions, beyond traditional improvements, that may assist in meeting the stated Purpose and Need. These sensitivity analyses included a high-growth land use scenario, a CAV scenario, and an additional transit ridership scenario. All three are summarized below.

High-Growth Land Use Sensitivity Analysis

For the purposes of the alternatives evaluation, this study used the existing 2040 DRCOG regional population and employment forecasts to evaluate the future travel demand for I-25. However, along the I-25 Central corridor, the potential exists that population and employment growth may exceed DRCOG's projections and result in a larger number of trips than originally forecasted. Based on a collaborative effort between the study team and Denver staff, a high-growth land use scenario was created, which estimated the potential additional trips, beyond what is already forecasted in the DRCOG models, that may occur if existing, large-scale development plans (shown in Figure 37) were to fully come to fruition by 2040.

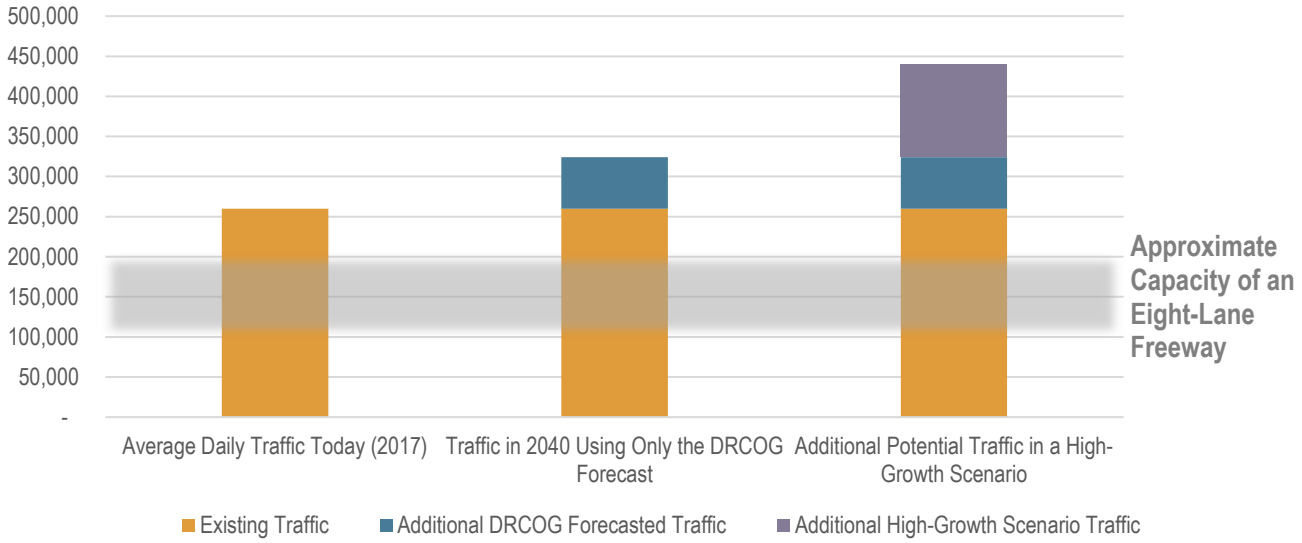
Figure 37 Development Areas Evaluated in the High-Growth Sensitivity Analysis



Source: Denver, 2019b

The results of this analysis indicated that there is a potential for an additional 116,000 daily trips on I-25 if all the planned major developments along I-25 Central were to be fully constructed by 2040. These trips would be in addition to the approximately 20 percent regional travel demand growth already forecasted by DRCOG. Figure 38 depicts the potential increase in trips on I-25 given this high-growth land use scenario. Additional information about the methodology and results of this analysis can be found in Appendix D, *I-25 Central Land Use Sensitivity Analysis Technical Memorandum* of the *Traffic and Safety Technical Report* (Attachment C).

Figure 38 Potential Additional Trips on I-25 in a High-Growth Scenario



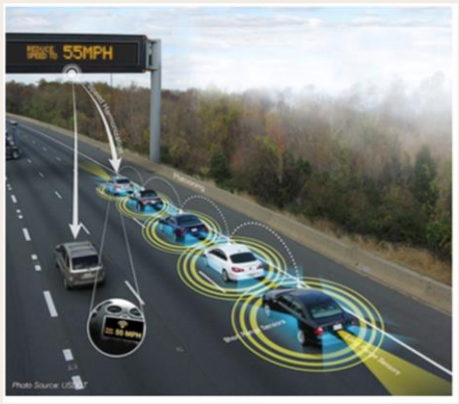
Source: Existing average daily traffic counts were obtained from in-field data collection efforts (Project Team, 2017b). Forecasted DRCOG 2040 trips were obtained from the DRCOG regional Travel Demand Model (DRCOG, 2017).

I-25 currently struggles to serve the level of demand that exists today. Without improvements, the additional travel demand estimated in this land use sensitivity analysis is likely to far exceed the highway's capacity. This will result in more severe congestion over more hours of the day than what is already forecasted to occur in the regular No Action Alternative. Therefore, this level of growth likely will need to be accommodated in many ways and modes, including those on and off of I-25. Accomplishing this will require a continued, coordinated effort between CDOT, Denver, and RTD.

Connected and Autonomous Vehicle Sensitivity Analysis

One of the biggest unknowns at the time of this PEL Study is the potential impact emerging technologies could have on transportation. Of these technologies, it is likely that the widespread adoption of CAVs could have the largest impact to I-25 Central. To understand the potential

Emerging technology has the potential to help traffic operate more efficiently and safely at high adoption rates, but infrastructure improvements and dedicated infrastructure will be necessary to maximize this benefit.



Source: FHWA, 2017

level of impact CAVs could have on I-25, a CAV sensitivity analysis was completed. A key goal of this sensitivity analysis was to understand if the widespread adoption of CAVs could provide enough benefit to I-25 to reduce the need for capacity improvements.

The results of this analysis showed that it would take a relatively high adoption rate—about 75 percent of all vehicles on I-25—to achieve a substantial (about 15 percent) improvement in highway capacity. However, this analysis also showed that additional capacity increase can be obtained through converting a potential managed lane into an exclusive CAV-only lane. By doing this, an additional 30-percent capacity can be obtained within the managed lane as compared to when the managed lane serves both CAVs and non-CAVs. Additional information and discussion about the potential impacts of CAVs on I-25 Central can be found in Appendix C, *I-25 Central Vissim Connected and Automated Vehicle Sensitivity Analysis Technical Memorandum*, of the *Traffic and Safety Technical Report* (Attachment C).

These results show that, depending on future adoption rates of CAV technology, meaningful benefits to traffic operations and safety could be achieved. Therefore, future studies and projects should examine/ consider the CAV adoption rates at the time of their evaluation and re-evaluate the need for additional capacity on I-25 at that time.

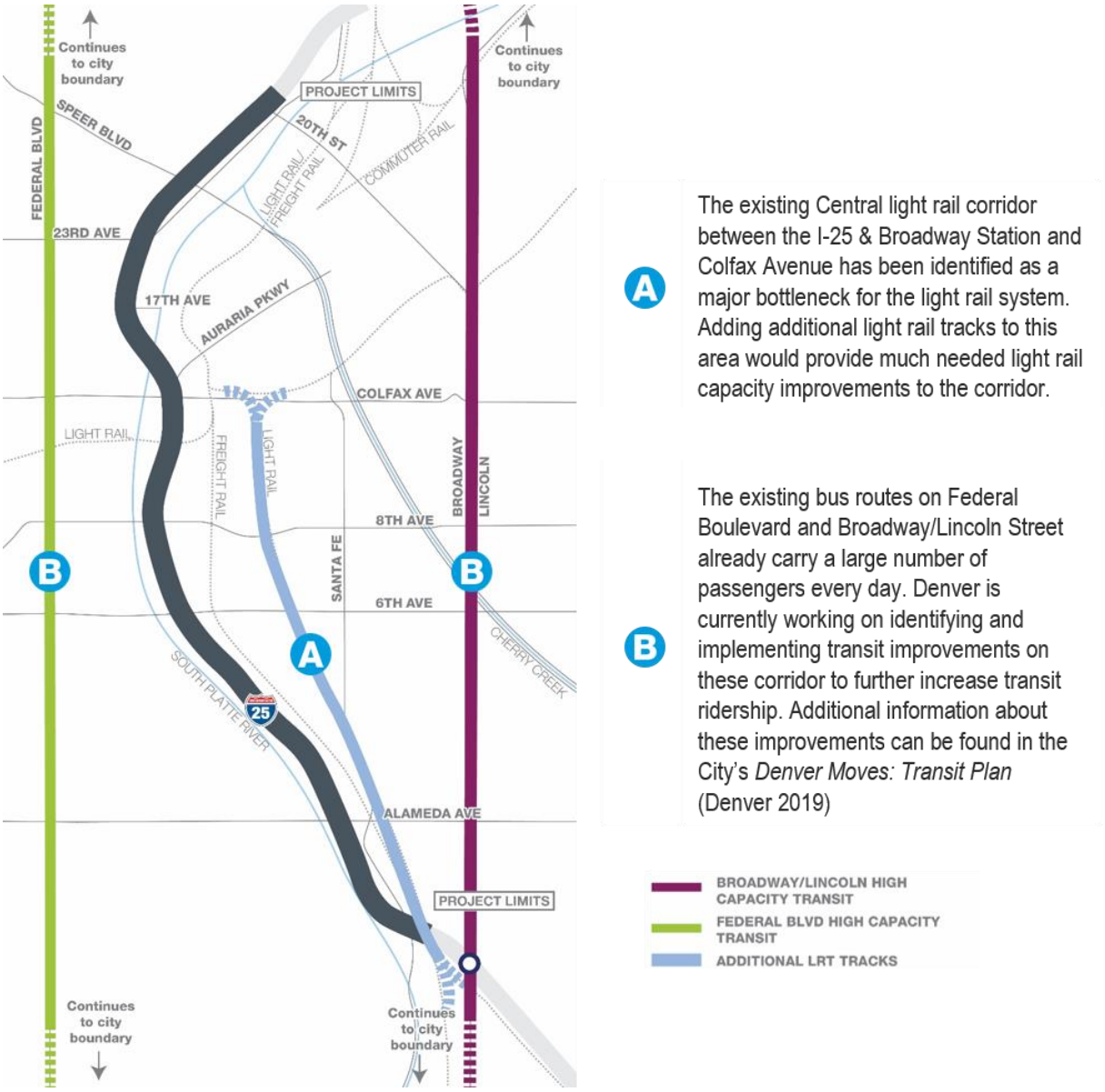
Additional Transit Ridership Sensitivity Analysis

As the population of the Denver metropolitan region and the land-use densities along the I-25 Central corridor continue to increase, there is a recognition that transit solutions will play a critical role within the transportation network. To this end, the I-25 Central project team, in partnership with RTD, completed a transit ridership sensitivity analysis that explored the potential benefits large-scale transit investments could have in supporting the PEL's Purpose and Need. The key question to be answered by this sensitivity analysis was whether major transit investments could provide enough congestion relief to reduce the need to add capacity to I-25 Central.

Based on this question, three key transit corridors were identified as having the highest potential to remove trips from I-25. These corridors included Federal Boulevard, Broadway/Lincoln Street, and the existing I-25 Central light rail corridor between the I-25 and Broadway Station and Colfax Avenue (Figure 39). These corridors already serve a high number of transit riders and, with capacity improvements, these passenger volumes could increase.

> Transit improvements will continue to be essential for regional mobility in the future and partnership opportunities will continue to be sought; however, the trips removed from I-25 from even a maximized transit system would not override the need for highway improvements.

Figure 39: Transit Corridors Evaluated in the Transit Sensitivity Analysis



The results of this analysis showed that—with major transit investments on Broadway/Lincoln Street, Federal Boulevard, and along the existing RTD light rail tracks (Figure 39)—there is a potential to remove approximately 15,000 daily trips from I-25 in 2040. These removed trips would be in addition to the trips already removed from the highway given the existing transit network. This reduction in trips shows that transit improvements could help reduce congestion and provide alternative travel options to I-25; however, providing only transit improvements likely would not provide enough benefit to reduce the need for additional capacity improvements on I-25. Additional information about the analysis methodology and findings of the transit ridership sensitivity analysis can be found in Appendix B, *I-25 Central Order-of-Magnitude Transit Ridership Development Process Technical Memorandum,* of the *Traffic and Safety Technical Report* (Attachment C).

It is important to note that the transit ridership numbers estimated in this analysis were based on improvements to existing transit facilities. However, there are currently a variety of other transit improvements being considered, including Colorado Front Range Rail and mobility hubs.

In addition to these regional-type facilities, Denver is taking an increasing local responsibility in implementing transit improvements through plans such as Denver's *Mobility Action Plan*, and organizational changes, such as the recent change from the Denver Department of Public Works to the Denver Department of Transportation and Infrastructure. These plans and organizational changes could result in greater travel mode-shift to transit and, therefore, a reduction in local vehicular travel demand.

Because these ideas, plans, and organizational changes are still in their early/conceptual phases, their impacts to travel are not well understood at this time. CDOT will continue to monitor the development of these ideas and strategies and examine ways in which these types of improvements could help address the needs of I-25.

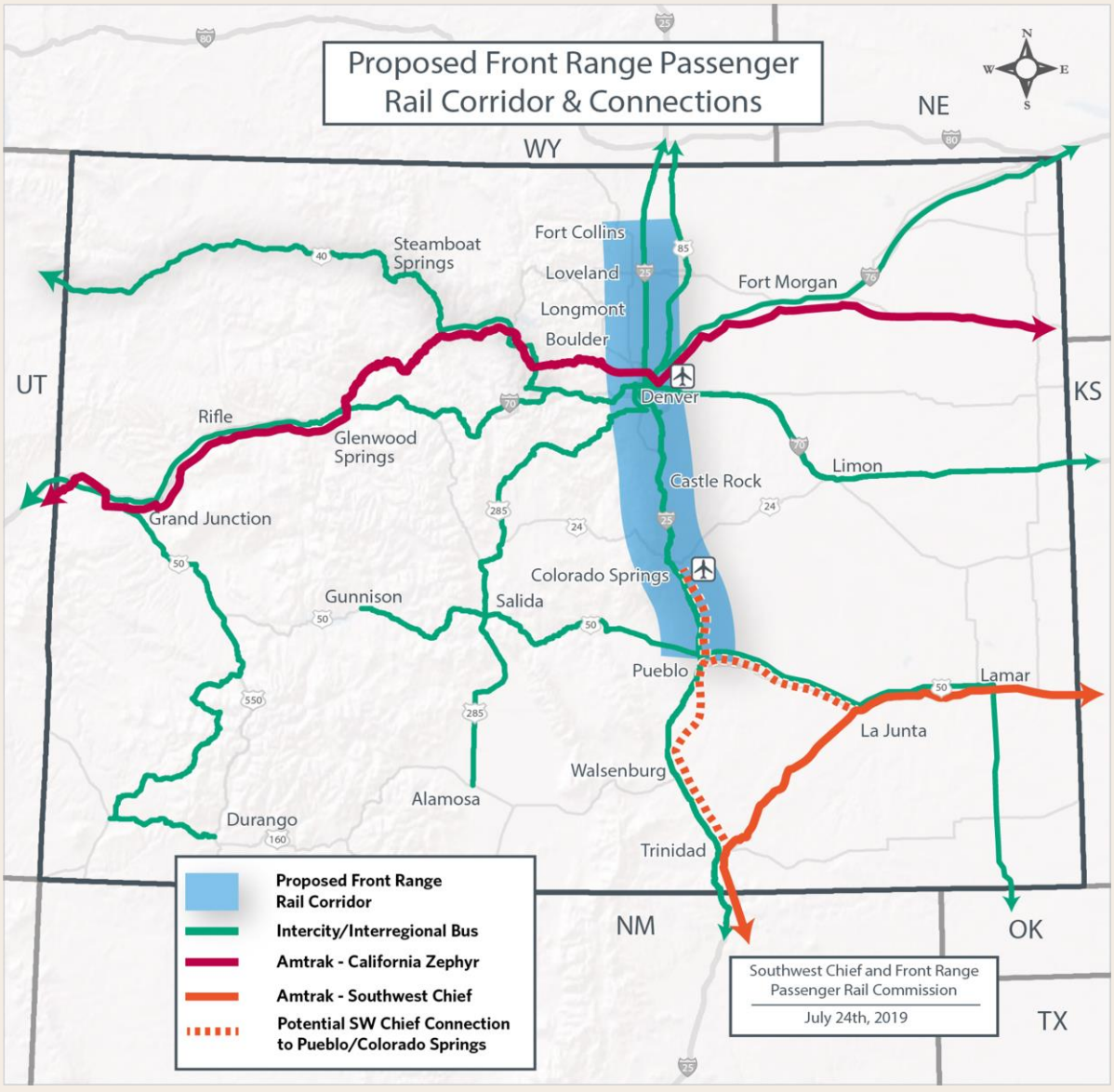
What is a mobility hub?

CDOT is committed to supporting multimodal options statewide and improving connections to transit and other travel modes. "Mobility hubs" are locations that create these opportunities that may include parking, access to bus and rail services, commercial amenities, electric vehicle charging stations, carpooling accommodations, and bike and car sharing amenities. Mobility hubs empower Coloradans to choose how they move around the state, ultimately providing links between transportation and broader goals.

Source: http://www.rtd-denver.com/westminster-station

What is Colorado Front Range Rail?

In response to new state legislation, CDOT is currently studying passenger rail service along the Front Range, extending from Fort Collins to Pueblo, including the Denver metropolitan region. The proposed rail parallels I-25 with future service that would complement interstate travel along the Front Range. Rail service benefits would include reductions of I-25 travel across the state, through the Denver metropolitan area, and along the I-25 Central corridor. This service would complement and enhance the improvement recommendations of this PEL Study.



Source: https://www.codot.gov/about/southwest-chief-commission-front-range-passenger-rail

Chapter 4 Environmental Resource Considerations

Although it is important to understand the environmental context and concerns when making recommendations and decisions, detailed environmental analysis is only meaningful when specific information about the layout and design of improvements is known. Because the PEL Study does not provide this level of detail, specific analysis on environmental resources was not done as part of this study. CDOT and FHWA agreed that only resources relevant to the study area warranted evaluation at this early stage in the planning process. This chapter documents the known environmental considerations along the I-25 Central corridor and provides resource-specific recommendations for evaluation in future, more-detailed studies.

What should be considered when scoping future NEPA projects and what are the critical schedule considerations?

Future projects may cause impacts to environmental resources identified in the study area. A full environmental analysis must be performed as part of the NEPA process for all future projects. Scoping and critical schedule considerations for each resource are described below and summarized in Table 12 at the end of this chapter.

Socioeconomic Conditions

The study corridor is located within the Denver metropolitan region, which is one of the fastest growing areas in the nation. Within Denver, the number of owner- and renter-occupied residential units is balanced and there is a very low percentage of vacant households. The study corridor intersects several neighborhoods, including multi-family units, single-family units, commercial businesses, and destination entertainment venues. There also are numerous schools, hospitals, clinics, emergency medical services, and recreational and entertainment opportunities within the study corridor.

A detailed Socioeconomics Technical Report is recommended for development during the NEPA process to identify more-specific information, including:

- Tax revenues
- Major contributors
- Employment by sector and labor force
- Employment centers
- Jobs versus housing balance
- Comprehensive plan coordination

Denver provides this information on a city-wide basis (Denver, 2017a); however, a more-thorough review is required to apply these analyses to the study area.

Critical Schedule Considerations—None anticipated.

Environmental Justice

The study area has a higher percentage of low-income households than Denver and a higher population of Hispanic or Latino residents. Therefore, a full environmental justice analysis must be performed as part of all future NEPA studies. Additionally, because there is a high population of Hispanic or Latino residents in the study area, a limited English proficiency (LEP) assessment must be performed in accordance with Executive Order 13166. All future public involvement activities must consider LEP and minority/low-income populations.

Critical Schedule Considerations—If the project has a potential of high and adverse impacts to the environmental justice populations, coordination should be initiated with affected populations early in the project to identify mitigation measures.

Right of Way

ROW widths vary considerably throughout the study corridor and some locations are very constrained. Future projects may have a general need for widening and could potentially impact numerous private and public properties, including adjoining railroad properties. Precise determination of ownership of the I-25 ROW will be needed as analysis moves into the NEPA stage. Any specific ROW or relocation considerations or recommendations would require a more-detailed schematic design and analysis, as may be completed during the NEPA phase of a project.

According to the *CDOT NEPA Manual* (CDOT, 2017c), the relocation and displacement analysis of the NEPA document should identify and discuss any residential, business, non-profit association, or farm operation relocations associated with the proposed project to:

- Ensure that community issues are identified and project impacts are addressed and incorporated into the decision-making process
- Try to avoid, minimize, or mitigate, where feasible, adverse community effects
- Ensure the incorporation of environmental protection and community impact considerations from the earliest stages of project or plan development
- Provide for the participation and consultation of communities affected by the proposed project throughout the life of the project development process

Critical Schedule Considerations—Any specific ROW or relocation considerations or recommendations would require a more-detailed schematic design and analysis, as may be completed during the NEPA phase of the project.

Air Quality

The study area is located within a severe nonattainment area for ground-level ozone and an attainment/maintenance area for carbon monoxide (CO) and particulate matter (PM_{10}). Transportation conformity regulations apply to projects based on recommended federal action, regional significance, and funding. Conformity regulations apply only to the approval, funding, or implementation of FHWA or Federal Transit Administration (FTA) projects, as specified in 40 Code of Federal Regulations (CFR) §93.102(a)(1)(iii). If conformity requirements would not apply because of the funding source, 40 CFR §93.121 also applies if the project is regionally significant, regardless of funding source.

The regulations also apply to projects that are, in whole or in part, in at least one ozone, CO, nitrogen dioxide (NO_2), PM_{10} and/or $PM_{2.5}$ nonattainment or maintenance area as specified in 40 CFR §93.102(b). If the project is not in one of these areas, conformity requirements do not apply. The project is in the ozone nonattainment area (severe) for Denver, and in the Denver maintenance areas for CO and PM_{10}.

The air quality conformity process has two levels: regional air quality conformity and project-level air quality conformity. The regional conformity analysis is conducted for the regional transportation plan (RTP) and the transportation improvement program (TIP). Project-level conformity is conducted for non-exempt projects that are funded and/or approved by FHWA or FTA. Project-level conformity includes a hotspot analysis in CO areas and for projects of air quality concern in PM nonattainment and attainment/maintenance areas. Conformity analysis may be required for projects that are developed out of this study, depending on the nature of the improvements and whether the project is determined to be regionally significant.

Critical Schedule Considerations

- If the project is determined to be a regionally significant project, a qualitative assessment of the air quality impacts may need to be performed during the NEPA phase
- The need for a qualitative or quantitative analysis will be determined by FHWA in coordination with the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD)
- In addition, such a project must be included in the DRCOG fiscally constrained RTP and the conforming TIP prior to the conclusion of the NEPA process and before beginning construction

Noise

The study area is bordered in several locations by sensitive noise receptors. Coupled with the expectation that future highway improvements will be classified as Type I projects, this requires a noise analysis to be completed during the NEPA process. Per the CDOT *Noise Analysis and Abatement Guidelines* (2015), a Type I project consists of capacity increases; alignment changes; or the addition of weigh stations, rest stops, ride-share lots, and toll plazas. When a project is identified as Type I, a noise analysis study is required if noise sensitive receptors are present within the environmental study area or a 500-foot study zone (CDOT, 2015).

Critical Schedule Considerations—To quantify the noise levels that the identified receptors are experiencing, field measurements at the existing and planned noise sensitive receptors will need to be made to develop a comparison between measured and modeled results.

Cultural Resources

Numerous archaeological and historic resources are located within the study area. Archaeological and historic resources are non-renewable, and, despite best efforts, cannot be completely restored or reconstructed after they are disturbed or destroyed. Because the data included in this study are the results of a literature review and prior investigations, they do not necessarily include all cultural resources present in the I-25 Central study corridor. Any scoping for future projects should include the Colorado State Historic Preservation Office (SHPO) and consulting parties, although it is unlikely archaeological impacts will be a concern because the study area has been highly disturbed. The following next steps are recommended:

- As individual projects are identified, a comprehensive Class III inventory should be conducted of the entire Area of Potential Effect (APE) for that project to ensure the identification of National Register of Historic Places (NRHP)-eligible resources
- When the Class III study is complete, a full effects evaluation for historic and archaeological resources then should be conducted on a project-specific basis
- For all projects, if unanticipated materials are encountered during construction, all work in the area should stop immediately until the find can be evaluated by a qualified cultural resource specialist

Critical Schedule Considerations—Data used in this analysis are incomplete and should be updated as additional resources age and are identified.

Geologic Resources and Soils

The study corridor, which lies within the Denver Basin geologic province, consists largely of a sequence of sedimentary rock formations deposited and preserved in the Denver Basin, a structural depression in north-central Colorado. Bedrock, known as the Denver Formation, of late Cretaceous and early Paleocene age is present beneath alluvial materials and/or fill materials at depths from 10 feet to 60 feet. Soils with high-, medium-, and low-swelling potential also have been mapped within the area.

Effects to geologic and soil resources may occur during the construction phase of the project, but they would not likely cause any geologic hazards or affect the predominant soil types identified in the study corridor. These effects include:

- Geologic Effects: Stability of surficial deposits, erosion of surficial materials, difficulty of excavation in the bedrock units, earthquakes, and high groundwater levels in some areas; all effects on geologic resources would occur during the construction phase of the project
- Soils Effects: Slope stability, expansive soils, shrink-swell potential, differential settlement, erosion, blowing dust, presence of bedrock, high groundwater levels, and flooding in some areas

Critical Schedule Considerations—None anticipated.

Hazardous Materials

A total of 825 facilities were identified in the hazardous materials database report for the PEL Study. Many of these facilities are located within and near the study corridor. CDOT requires an initial site assessment (ISA) or a Phase I environmental site assessment (ESA) for Categorical Exclusion projects or acquisition of properties for ROW with potential hazardous materials concerns. A modified environmental site assessment (MESA) is required for environmental assessments (EAs) and EISs. Intrusive evaluations (Phase II ESA) also may be required, including assessment of soil or groundwater for the presence of chemicals of concern or other hazardous materials liabilities.

Critical Schedule Considerations

- **Phase I ESAs, MESAs, ISAs:** A Phase I ESA or ISA can be completed in approximately one to two months if right of entry does not cause delays. A MESA may require two to three months depending on the scale of the assessment.
- **Phase II:** If a Phase I ESA or ISA reveals potential or recognized on-site contamination, a Phase II assessment may be required. A Phase II assessment can be completed within one to two months provided the necessary subsurface sampling and sampling analysis can be conducted without weather, ROW, funding, or other delays.

- **Remedial Actions:** Based on the results of the Phase II investigation, if remedial actions are recommended or required, the project could be significantly delayed. Remedial action does not have a standard time requirement but is dependent on the contaminants, extent of contamination, and physical setting. Coordination with property owners and/or regulatory agencies also may cause delays.
- **Validity of Phase I ESA or ISA:** Phase I ESAs and ISAs are valid for 180 days and may be updated between 180 days and one year after completion. After one year, the report may be used only as a reference in a new Phase I ESA or ISA due to the potential for changes in on-site conditions.

Parks and Recreation/Section 6(f) Resources

Numerous parks, trails, and recreational facilities are located within the study corridor. Nine of these facilities are protected under Section 6(f) of the Land and Water Conservation Fund Act. If a proposed action would affect a Section 6(f) site, then a Section 6(f) evaluation will be required. Section 6(f) prohibits converting property acquired or developed with Land and Water Conservation Fund grant monies to a non-recreational purpose without approval of the National Park Service (NPS). The conversion protection requirement administered by the NPS in cooperation with Colorado Parks and Wildlife (CPW) strongly discourages casual discards and conversions of state and local park and recreation facilities to other uses. Section 6(f) evaluation includes identifying the Section 6(f) properties within the NEPA study area, calculating the potential impacts of the project alternatives on these properties, and consulting and coordinating among the official with jurisdiction (OWJ) (most likely Denver Parks and Recreation Department), CPW, and NPS. If there are impacts to the property, CDOT must determine the approximate size of the Section 6(f) property that will be converted either as ROW or as a permanent easement. CDOT, in cooperation with the OWJ, must identify replacement land that is of reasonably equivalent size, usefulness, and location, and of at least equal fair market value.

Under NEPA, environmental consequences of improvements and alternatives should be assessed and evaluated to determine the extent of impact, including social, economic, and environmental. Given the general importance of parks within communities, minimizing potential impacts of improvements and alternatives will be important. In addition, social resources, including parks within communities, require evaluation of impact and any potential issues should be identified as early in the process as possible.

Critical Schedule Considerations

- Section 6(f) evaluations are anticipated for this project
- Adequate time must be built into the NEPA process and design schedule to avoid construction delays
- If a Section 6(f) conversion of land is necessary, CDOT must identify replacement land of equal or higher recreational value at a one-to-one ratio
- The OWJ, CPW, and NPS must approve the replacement land
- The CPW and NPS will not permit the conversion of Section 6(f) land to occur until the replacement property has been fully acquired and is available to serve public outdoor recreational uses
- Because the functional replacement must occur before the conversion of the Section 6(f) property, it is imperative to involve the CDOT ROW Office and inform them of the requirements of Section 6(f) land for the project
- Coordination with adjacent projects would be crucial to any identified improvements along this stretch

Section 4(f) Resources

Section 4(f) of the Department of Transportation Act affords protection to publicly owned land in the form of a public park, recreation area, or wildlife and/or waterfowl refuge of national, state, or local significance, and land of an historic site of national, state, or local significance. Section 4(f) protected properties usually are considered in two categories: historic and non-historic.

There are numerous Section 4(f) resources adjacent to and within the study corridor. A successful Section 4(f) evaluation will hinge on two things: the elimination of alternatives, and the potential project's purpose and need. Because the Section 4(f) bar is extremely high, alternatives eliminated early on may represent either feasible and prudent Section 4(f) avoidance alternatives or least overall harm alternatives. Efforts to document that eliminated alternatives are not feasible and prudent avoidance alternatives as defined in 23 CFR 774 are important. Document that an eliminated alternative would use Section 4(f) properties, or that an alternative is not prudent according to the six tests in 23 CFR §774.17. Purpose and need and costs of extraordinary magnitude factor importantly in these six tests for prudence.

Critical Schedule Considerations

- An individual Section 4(f) evaluation can be expected to take extended time in a project's NEPA schedule
- For historic Section 4(f) resources, the Section 106 consultation process may add additional time
- For non-historic Section 4(f) resources, consultation with the OWJ may add additional time
- Additional reviews and coordination may be required for an individual Section 4(f) evaluation, including with the U.S. Department of the Interior (DOI) and FHWA

Visual and Aesthetic Considerations

The study corridor is located within the Front Range Urban Zone, a highly developed, relatively dense urban and suburban land use consisting of the Denver and Colorado Springs metropolitan areas, as well as the communities to the north and east of Denver. Since transportation infrastructure can complement or detract from the aesthetics of the urban landscape character, design elements should consider the surrounding area and any relevant neighborhood plans and associated design criteria.

Discussion with local agencies and interested stakeholders to identify possible concerns regarding design elements should be undertaken.

As part of the *Guidelines for the Visual Impact Assessment of Highway Projects*, FHWA has produced a Visual Impact Assessment (VIA) scoping questionnaire that should be completed to determine the appropriate level of VIA necessary to support any future NEPA assessment (FHWA, 2015). The scoping questionnaire consists of 10 questions and provides an explanation of each with a scoring system to help determine the type of VIA.

Critical Schedule Considerations

- The ordinances that protect the view planes of certain valued views means that the heights of new development within the view plane are restricted; while not schedule critical, this may impact design considerations going forward

- Early coordination with Denver, particularly to help identify any sensitive visual receptors, in combination with robust public involvement will enable the project to consider aesthetic requirements within the design and will help keep the project on schedule

Floodplains

The study corridor crosses the South Platte River Floodplain in several locations. Alternatives should involve as little impact to the flood zones as practicable. Any effects that the alternatives have on the floodplain must not raise the level of the base flood elevation, increase the spread of the 100-year flood zone, or add any structures to the floodplain that were not previously within it.

Critical Schedule Considerations—Due to the large overall scale of this project, it is recommended that a Conditional Letter of Map Revision be submitted to the Federal Emergency Management Agency (FEMA) prior to final design to help ensure that any design chosen will not violate FEMA's requirement of no rise within floodplains.

Drainage and Water Quality

Offsite basins flow toward and across I-25 and the existing cross drains and storm drain systems convey these offsite flows through I-25 to the South Platte River. Surface water resources within the study corridor are impaired for recreation and water supply because of high levels of arsenic, *Escherichia coli*, and nitrate.

Project alternatives will be reviewed to identify possible impacts to surface waters, groundwater, and water quality. Mitigation measures for each will be reviewed and documented. Permitting requirements for potential project activities will be identified.

It is anticipated that the requirements of the CDOT Municipal Separate Storm Sewer System (MS4) Permit will be applied throughout the study area; however, requirements of the Denver MS4 Permit may apply if project improvements extend outside of the CDOT ROW.

Critical Schedule Considerations

- Drainage resources, including major cross drains, will require early coordination with local agencies to accommodate offsite flows crossing I-25 (master planning, design, funding, and construction of these major cross drains, outfall system plans, and capital improvement projects can take several years for the local agencies)
- Identification of potential permanent water quality control measures and locations will require early coordination, as they may require additional ROW or impact additional environmental resources

Wetlands and Other Waters of the U.S.

The South Platte River, Cherry Creek, Lakewood Gulch, and Weir Gulch are the predominant waters in the study corridor. The U.S. Army Corps of Engineers (USACE) has previously determined that these waters, and the wetlands adjacent to them, are jurisdictional waters of the U.S. regulated under the Clean Water Act.

Because of the possibility of having to use the NEPA/404 Merger Process, the presence of and estimates of impacts to wetlands and other waters of the U.S. should be determined as early as possible during the pre-scoping process of a project to determine if the impacts trigger the need for an

individual permit from the USACE and activate the merger process. The merger process and obtaining an individual permit require much more time and effort than authorization under one or more Nationwide Permits.

Critical Schedule Considerations

- Early in the NEPA process, a wetland vegetation-based delineation may be appropriate for alternatives development
- Formal delineation can be done when the alternatives have been narrowed to those being fully evaluated

Vegetation and Noxious Weeds

Riparian plants located along the South Platte River and its tributaries are the most abundant type of vegetation within the study corridor. However, parks within the study corridor are landscaped with native and non-native species.

Since most of the vegetation present in the study corridor is found along the riparian corridor, tasks during the NEPA process for projects would be focused on documenting the location of critical habitat in affected parts of the study corridor. This information should be used to obtain Colorado Senate Bill 40 (SB40) certification from CPW during future NEPA processes, and should inform how the project's work timing, schedules, and best management practices would affect fish and other wildlife in SB40 jurisdiction.

Critical Schedule Considerations—None anticipated.

Wildlife and Fisheries

The highly urbanized nature of the study corridor significantly limits potentially available habitat to small, low-quality patches of vegetation. The highest quality undeveloped habitat is along the South Platte River, Cherry Creek, Lakewood Gulch, and Weir Gulch. Tasks during the NEPA process would be focused on documenting the lack of habitat in other parts of the study corridor and obtaining concurrence from the United States Fish and Wildlife Service (USFWS) and CPW that proposed alternatives (and, more importantly, work timing, schedules, and best management practices) would have no effect on migratory bird species, raptors, or eagles. Also, coordination with CPW should occur so that potential affects to fish species are addressed.

Critical Schedule Considerations

- Migratory bird (including eagles and raptors) survey and management often are critical schedule components
- Bridge or box culvert work that may disturb nesting birds should be completed before birds begin to nest or after the young have fledged (typically between April 1 and August 31)
- Bald Eagles and other raptors may nest as early as February 15 on the Front Range of Colorado
- Different bird species breed at different times of the year, and further coordination with CPW should occur to determine if there are any schedule concerns

Threatened and Endangered Species

Suitable habitat for federal and state-listed threatened and endangered species and state species of concern is lacking in the study corridor. As a result, threatened, endangered, and species of concern are not expected to be present. However, future projects have the potential to indirectly affect downstream species in the Platte River. Therefore, tasks during the NEPA process would be focused on documenting the lack of habitat in the study corridor and obtaining concurrence from the USFWS and CPW that potential effects to Platte River species are addressed programmatically under the South Platte Water Resources Activities Program and the programmatic biological assessment.

Critical Schedule Considerations—Fieldwork for more-detailed assessments of the study corridor for potential habitat for federal and state-listed species may require seasonal windows within which surveys must be completed (e.g., surveys for Ute ladies'-tresses orchid must be completed when the species is flowering).

Cumulative Impacts

The PEL Study identified the following resources as having cumulative effects over the course of development of the I-25 Central PEL Study: transportation, land use, Section 4(f) resources, environmental justice, air quality, water quality, and noise. Cumulative impact analyses should be performed for those resources directly impacted by future transportation projects. Cumulative impact analysis should focus on resources for which the project will have effects similar to other actions in the community study area and/or resources that have been historically affected by cumulative actions.

> Cumulative impacts result from the incremental impact of the action when it is added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts could result from individually minor, but collectively significant, actions that take place over time (Council on Environmental Quality 40 CFR §1508.7).

Critical Schedule Considerations—Discussion with local agencies and interested stakeholders to identify possible concerns regarding design elements should be undertaken as part of the project.

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Socioeconomic Conditions	• More detailed analysis of social and economic parameters and an assessment of how alternatives may impact these parameters	• None anticipated
Environmental Justice	• Full environmental justice analysis and LEP assessment must be performed as part of the next stage of the NEPA process • A robust public involvement process must be initiated to reach out to affected communities and invite them to be involved in the decision-making process	• None anticipated • If the project has a potential of high and adverse impacts to the environmental justice populations, coordination should be initiated with affected populations early in the project to identify mitigation measures
Right of way	• Boundary survey of existing I-25 ROW • Title research of existing I-25 ROW • Title research of properties adjacent to I-25 ROW • Development of comprehensive ownership mapping and ROW plans • Relocation and displacement analysis	• Any specific ROW or relocation considerations or recommendations would require a more-detailed schematic design and analysis, as may be completed during the NEPA phase of the project
Air Quality	• Potential schedule and coordination implications of project-specific air quality analysis • Early coordination and consultation should occur	• If the project is determined to be a regionally significant project, a qualitative assessment of the air quality impacts may need to be performed during the NEPA phase • The need for a qualitative or quantitative analysis will be determined by FHWA in coordination with the Air Pollution Control Division • In addition, such a project must be included in the DRCOG fiscally constrained RTP and the conforming TIP prior to the conclusion of the NEPA process and before beginning construction

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Noise	• Project-specific noise measurements, determination of traffic noise impacts, and evaluation of traffic noise abatement • Per CDOT's guidance on noise abatement, primary consideration should be given to exterior areas surrounding residential uses or areas of frequent human use, such as parks and commercial areas • Mitigation measures must be reasonable and feasible to be approved by CDOT	• To quantify the existing noise levels that the identified receptors are currently experiencing, field measurements at the existing and planned noise sensitive receptors will need to be made to develop a comparison between measured and modeled results
Cultural Resources	• As individual projects are identified, a revised APE should be identified • A comprehensive Class III inventory should be conducted of the entire APE for that project to ensure the identification of NRHP-eligible resources • When the Class III study is complete, a full effects evaluation for historic and archaeological resources then should be conducted on a project-specific basis	• Data used in this analysis are incomplete and should be updated as additional resources age and are identified
Geologic Resources and Soils	• More detailed analysis of geologic resources and soils and an assessment of how alternatives may impact these resources	• None anticipated

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Hazardous Materials	• Refinement of alternatives and study area boundaries for future projects will assist in evaluating hazardous material resource options • Additional assessment and/or field investigations may be required in future NEPA activities, ROW acquisition, or the development of specific materials management or institutional controls required during construction • A hazardous materials assessment, such as a MESA, typically would be needed as part of future project development • Properties to be acquired also may require individual site assessments and/or preliminary site investigations as part of the ROW acquisition process, and may require remediation prior to acquisition or development	• Phase I ESAs, MESAs, ISAs: A Phase I ESA or ISA can be completed in approximately one to two months if right of entry does not cause delays. A MESA may require two to three months depending on the scale of the assessment. • Phase II: If a Phase I ESA or ISA reveals potential or recognized on-site contamination, a Phase II assessment may be required. A Phase II assessment can be completed within one to two months provided the necessary subsurface sampling and sampling analysis can be conducted without weather, ROW, funding, or other delays. • Remedial Actions: Based on the results of the Phase II investigation, if remedial actions are recommended or required, the project could be significantly delayed. Remedial action does not have a standard time requirement but is dependent on the contaminants, extent of contamination, and physical setting. Coordination with property owners and/or regulatory agencies may also cause delays. • Validity of Phase I ESA or ISA: Phase I ESAs and ISAs are valid for 180 days and may be updated between 180 days and 1 year after completion. After one year, the report may be used only as a reference in a new Phase I ESA or ISA due to the potential for changes in on-site conditions.

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Parks and Recreation/ Section 6(f) Resources	• Potential schedule and coordination implications of Section 6(f) property conversions • Attempt to avoid impacts to and conversions of Section 6(f) properties • If avoiding Section 6(f) properties is not a viable option, early coordination and consultation should occur	• Section 6(f) evaluations are anticipated for this project • Adequate time must be built into the NEPA process and design schedule to avoid construction delays • If a Section 6(f) conversion of land is necessary, CDOT must identify replacement land of equal or higher recreational value at a one-to-one ratio • The OWJ, CPW, and NPS must approve the replacement land • The CPW and NPS will not permit the conversion of Section 6(f) land to occur until the replacement property has been fully acquired and is available to serve public outdoor recreational uses • Because the functional replacement must occur before the conversion of the Section 6(f) property, it is imperative to involve the CDOT ROW Office and inform them of the requirements of Section 6(f) land for the project • Coordination with adjacent projects would be crucial to any identified improvements along this stretch
Section 4(f) Resources	• Section 4(f) protection of all resources should be verified in terms of ownership, major purpose, and NRHP eligibility early on to consider during project design or programming	• An individual Section 4(f) evaluation can be expected to take extended time in a project's NEPA schedule, and is most effective after the Section 106 process is complete, adding more time to schedule • For historic Section 4(f) resources, the Section 106 process may add additional time • For non-historic Section 4(f) resources, consultation with the official(s) with jurisdiction may add additional time • Additional reviews and coordination may be required for an individual 4(f) evaluation, including DOI and FHWA

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Visual and Aesthetic Considerations	• Further characterization of current conditions in the study area through additional site observation and discussion with local agencies • When project alternatives are developed, a VIA questionnaire must be completed to determine the level of VIA needed in support of NEPA documentation	• The ordinances that protect the view planes of certain valued views means that the heights of new development within the view plane are restricted; while not schedule critical, this may impact design considerations going forward • Early coordination with Denver, particularly to help identify any sensitive visual receptors, in combination with robust public involvement will both enable the project to consider aesthetic requirements within the design, and will help keep the project on schedule
Floodplains	• Attempt to avoid or have little impact to floodplains • In the case of any impacts, the means of mitigating these impacts will need to be incorporated within the design alternative	• Due to the large overall scale of this project, it is recommended that a Conditional Letter of Map Revision be submitted to FEMA prior to final design to help ensure that any design chosen will not violate FEMA's requirement of no rise within floodplains
Drainage and Water Quality	• Locations and expected capacity of major cross drains should be coordinated with Denver and the Urban Drainage and Flood Control District to minimize future construction impacts to I-25 from local agency drainage projects • Current design criteria and MS4 permit requirements should be confirmed • Existing permanent water quality features also should be field verified • Alternatives should be evaluated to determine potential impacts to shallow groundwater to identify the need for dewatering and to identify existing groundwater characteristics	• Drainage resources, including major cross drains, will require early coordination with local agencies to accommodate offsite flows crossing I-25 (master planning, design, funding, and construction of these major cross drains, outfall system plans, and capital improvement projects can take several years for the local agencies) • Identification of potential permanent water quality control measures and locations will require early coordination, as they may require additional ROW or impact additional environmental resources

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Wetlands and Other Waters of the U.S.	• Fieldwork for wetland and jurisdictional determinations should be completed • After waters and wetlands have been mapped, the alternatives will include measures to avoid or to minimize unavoidable impacts • Unavoidable impacts for each alternative will be calculated and the need for nationwide or individual permit Section 404 authorization can be determined in consultation with the USACE • Impacts to any wetlands must be mitigated for with either on-site creation of compensatory mitigation areas or use of USACE/CDOT approved wetland mitigation bank credits	• Early in the NEPA process, a wetland vegetation-based delineation may be appropriate for alternatives development • Formal delineation can be done when the alternatives have been narrowed to those being fully evaluated
Vegetation and Noxious Weeds	• Prior to choosing project alternatives, vegetation communities should be assessed for quality and abundance to help determine the least damaging practicable alternative; CPW should be consulted, both to request certification under SB40, but also to determine if any vegetation communities are known to act as wildlife corridors, breeding habitat, or nesting sites	• None anticipated
Wildlife and Fisheries	• During NEPA evaluation, migratory bird habitats should be mapped and the quality of them assessed to determine potential impacts • Preference should be given to avoid old growth trees and large undisturbed patches of shrubs or trees	• Migratory bird (including Eagles and raptors) survey and management often are critical schedule components • Bridge or box culvert work that may disturb nesting birds should be completed before birds begin to nest or after the young have fledged (typically between April 1 and August 31) • Bald Eagles and other raptors may nest as early as February 15 on the Front Range of Colorado • Different bird species breed at different times of the year, and further coordination with CPW should occur to determine if there are any schedule concerns

Table 12 Summary of Scoping and Critical Environmental Schedule Considerations

Resource	Scoping Considerations	Critical Schedule Considerations
Threatened and Endangered Species	• At NEPA scoping, coordination with CPW is critical to ensure future SB40 permit considerations are covered by the analysis	• Fieldwork for more detailed assessments of the study area for potential habitat for federal and state listed species may require seasonal windows within which surveys must be completed (e.g., surveys for Ute ladies'-tresses orchid must be completed when the species is flowering)
Cumulative Impacts	• Early and continued coordination with Denver, in combination with robust public involvement, would enable the project to consider ongoing discussion on the long-term effects on resources important to the community and will help keep the project on schedule	• Discussion with local agencies and interested stakeholders to identify possible concerns regarding design elements should be undertaken as part of the project

Chapter 5 Public and Agency Involvement

A comprehensive program of public and agency involvement activities, tailored specifically for this study, was conducted. This study incorporates feedback received from various groups and communities engaged specifically through a series of technical meetings, focus groups, public meetings, a survey, and online engagement platforms. Comments and input received helped frame the purpose and need, goals, and objectives and ultimately informed the study's findings and recommendations.

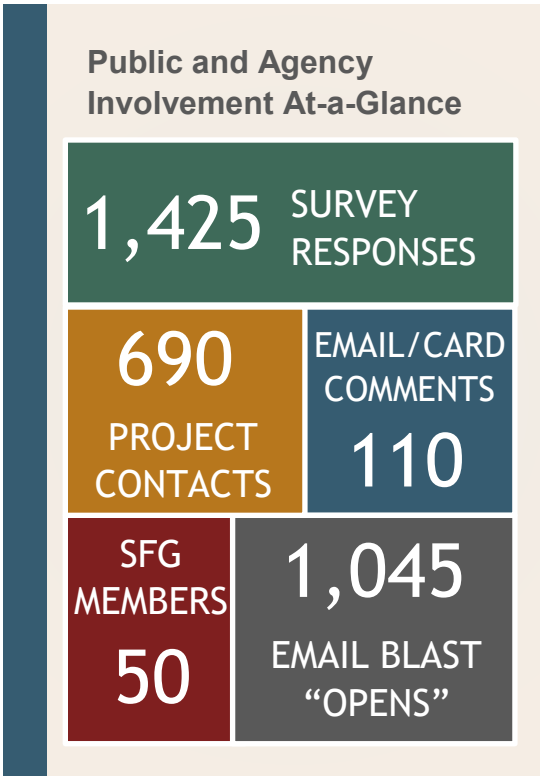
A study-specific program of public and agency outreach activities was defined at the outset of the I-25 Central PEL Study. This program was designed to provide key input and comments at each critical phase or step of the study process—Purpose and Need, Concept Evaluation, Alternatives Evaluation, and Study Recommendations. Its design and execution were based on the overarching desired outcomes to:

*Details of the public and agency involvement activities conducted in support of the I-25 Central PEL Study are provided in Attachment D, **Agency and Public Coordination Summary**.*

- Increase public and stakeholder awareness of issues concerning the I-25 Central corridor through a public-education campaign
- Balance and integrate competing needs
- Ensure agreement between the sponsoring and participating agencies
- Listen to stakeholders and get support for potential improvements
- Establish public confidence in CDOT and this PEL process
- Allow early identification of critical issues and problems

To understand the needs of users and the communities in and around the I-25 Central corridor, the study engaged stakeholders representing the corridor's diverse geographies, interests, and sectors. Stakeholders included bicycle and pedestrian users, businesses, cultural and historic preservation interests, community and neighborhood associations, elected officials, freight providers, environmental and recreation advocates, landowners, railroads, and sports venues.

Multiple project teams and working groups were convened, including an Executive Oversight Committee, a Project Management Team, a Project Status Group, a Technical Advisory Committee, and the SFG. A brief description of each group is provided below.



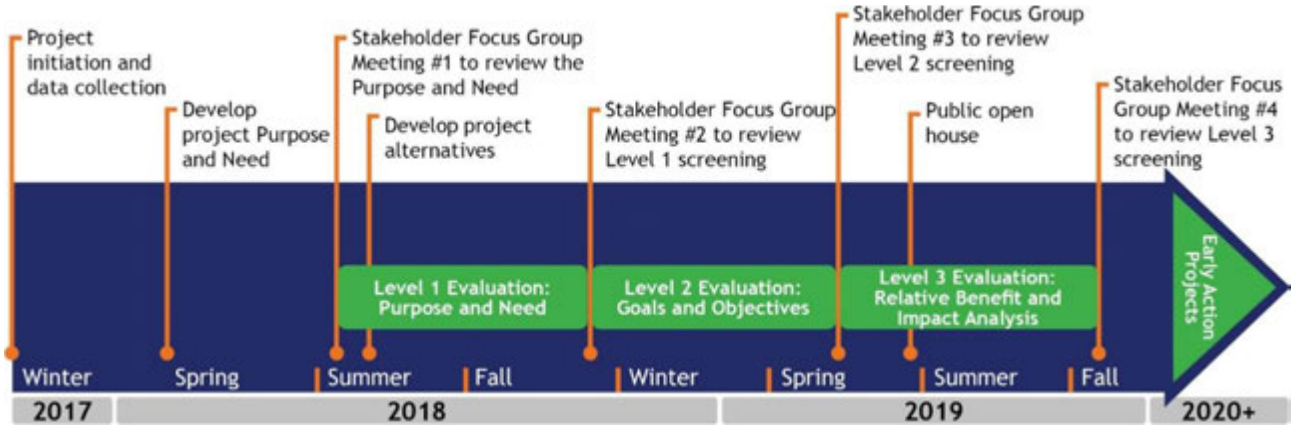
- **Executive Oversight Committee:** Operated to resolve issues, make decisions on policy issues, and provide feedback on the status of activities and decisions. The Executive Oversight Committee was made up of policy-level representatives of Denver, CDOT, DRCOG, and FHWA.
- **Project Management Team:** Conducted project management and project-level decision-making for the project. This group included representatives from CDOT, Denver, FHWA, and consultants.
- **Project Status Group:** Ensured the project was on schedule, on budget, and meeting its deliverables. The Project Status Group considered how issues would impact different aspects of the PEL and identified strategies to address them. The group was made up of CDOT staff and consultants.
- **Technical Advisory Committee:** Provided the study and project team with technical input. This group included representation from CDOT, Denver, the Colorado Motor Carriers Association, DRCOG, FHWA, and RTD.
- **Stakeholder Focus Group (SFG):** Provided input on the project's processes and outcomes. This group included numerous technical experts, advocates, and community members.

External public communications included stakeholder and public meetings, one-on-one stakeholder interviews, and an innovation brainstorming workshop. Communication aids supporting and increasing public awareness included newsletters, announcements, and mailings; media relations tools and press releases; a study website; social media tools; a study email list; an "outreach toolkit" for SFG members; and an outside organization outreach program.

How was public and agency involvement integrated into the process?

This study started in the fall of 2017 and concluded in the spring of 2020. At each step of the study's progression, as shown in Figure 40, the study's analyses and decision-making processes were conducted in tandem with the engagement of the agencies, stakeholders, and public. The discussions and comments offered corresponded with the progression of the study process. Initial engagement focused on the Purpose and Need and study goals. Subsequently, the study alternatives were evaluated at two progressively more-detailed levels of screening. Stakeholders provided comments and input at each of these successive evaluations.

Figure 40 Public and Agency Input Process



What input was received?

Through the stakeholder outreach program, combined with a stakeholder survey, comments were received and incorporated into the study. General comments received through meetings, one-on-one discussions, and email communications early in the study were categorized into five major themes—Mobility, Safety, Neighborhoods, Impacts, and Land Use. Input and feedback received is summarized in Table 13.

Table 13 Summary of Stakeholder Input and Feedback

Theme	Summary
Mobility	• Reduce congestion, especially in and around event venues such as Empower Field at Mile High Stadium • Consider options to reduce or remove turbulence on the highway from vehicles merging and weaving • Improve multimodal transportation opportunities and connections along and across the interstate
Safety	• Provide designs that reduce driver distraction, especially around crashes and incidents along the corridor, and ensure that facilities can accommodate the needs of emergency responders • Improve safety for pedestrians and bicyclists • Increase the clearance on low bridges
Neighborhoods	• Consider the needs and character of surrounding neighborhoods and the people who live there • Consider the impacts of access changes on neighborhoods, businesses, and event venues
Impacts	• Consider noise, air quality, and water quality impacts from the interstate • Explore opportunities to reduce the land required for the interstate • Consider the potential of contaminated ground around the corridor, especially near the South Platte River and industrial sites
Land Use	• Coordinate with ongoing planning efforts around Denver • Consider the interstate impacts on economic development opportunities

In addition to general feedback, an opinion survey was disseminated to the study's stakeholders. The survey, which received 1,425 responses between January 2019 and June 2019, asked questions about frequency of use, types of use, and reasons for use of the corridor. Survey topics were organized around the five themes from the earlier stakeholder feedback.

How was input and feedback included in the PEL process?

Input and feedback gained from the stakeholders and survey helped inform the study process. As appropriate, as shown in Table 14, input was incorporated into the study as follows:

- Purpose and Need—Included as a principal element and/or in the supporting technical analyses defining the needs
- Secondary Goal—Included as an adjunct to the Purpose and Need in the form of a goal, and included in the evaluation criteria for the screening of alternatives
- Definition of Alternatives—Included as a principal element, consideration, or feature in the definition of the alternatives, including the coordination with interests directly involved in the topic
- Evaluation Criteria—Included as criteria in the evaluation of the alternatives and recommendations

Table 14 How Input and Feedback were Addressed by the Study

Theme/Topic	Description	Addressed by Study			
		Purpose & Need	Secondary Goal	Definition of Alternatives	Evaluation Criteria
Mobility					
Bicycle and Pedestrian	Improve bicycle and pedestrian facilities across and along the corridor with better connections to local networks.			X	X
Freight	Maintain service for semi-trucks within the corridor.			X	
Highway Expansion	Add additional lanes to I-25 and expand the current footprint.			X	
Managed Lanes	Add HOV, toll, express, transit only, or through traffic only lanes.			X	
Other Highway Impacts	Consider impacts to other regional highways, such as E-470, C-470, and others.				X
Technology	Deploy technologies along the corridor to manage traffic and prepare for future emerging automated vehicle technologies.		X	X	X
Transit	Provide light rail, Front Range Rail, bus and rapid bus networks, and mobility hubs within the corridor and plan for additional future facilities and routes.			X	

Table 14 How Input and Feedback were Addressed by the Study

Theme/Topic	Description	Addressed by Study			
		Purpose & Need	Secondary Goal	Definition of Alternatives	Evaluation Criteria
Safety					
Access	Improve direct access to I-25 by adding, eliminating, or reconfiguring access points for better operations.	X		X	X
Congestion	Improve I-25 to reduce congestion and improve travel time reliability.	X		X	X
Geometry	Improve curves, visibility, posted speeds, and the roadway cross section within the corridor.	X		X	X
Shifting or Induced Demand	Consider how increased capacity will shift travel onto the interstate and not decrease congestion.	X			
Safety	Improve the overall safety of corridor users and crossers, including vehicles, bicyclists, and pedestrians.	X		X	X
Neighborhoods					
Cross Connectivity	Provide improved access across and along I-25 for local traffic and users.	X		X	X
Lid	Consider a lid over I-25 to cover all or part of the highway and connect the adjacent neighborhoods.			X	
Local Impact	Consider effects on neighborhoods and businesses along the highway.		X	X	X
Impacts					
Environmental Impacts	Reduce impacts to the environment, including the South Platte River, air quality, and climate change.		X	X	X
ROW	Address concerns about impacts to adjacent properties and businesses, and address environmental justice issues.		X	X	X
Land Use					
Growth	Consider population and traffic growth in the study.	X	X	X	X

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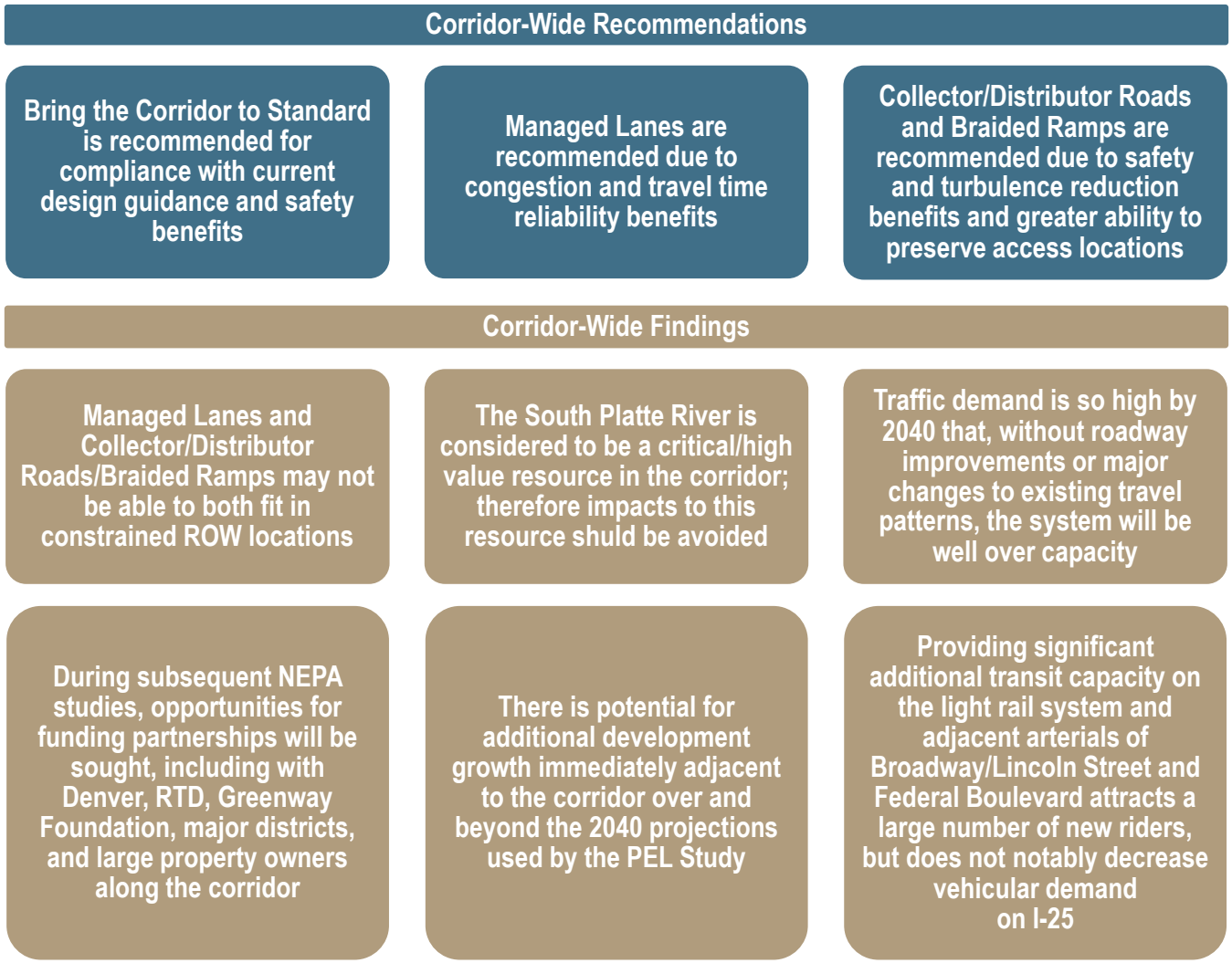
Chapter 6 Action Plan

The Action Plan identifies the path forward and outlines the sequence of incremental steps that should be taken to achieve recommendations identified in this PEL Study. This chapter documents the Action Plan for this PEL Study.

How was the Action Plan developed?

The PEL Study resulted in the recommendation of three corridor-wide alternatives (as described in detail in Chapter 3), as well as related findings shown in Figure 41. This Action Plan documents the three alternatives by breaking them down into smaller individual projects that are expected to have independent utility, and it describes the merits, impacts, and estimated costs of each.

Figure 41 Corridor-Wide Recommendations and Findings



Considerations for subsequent NEPA Studies

In Chapter 3, this PEL recommends three alternatives for consideration in future NEPA processes. None of the three can individually address all needs of the corridor. Future NEPA studies will need to consider the elements of all three alternatives (plus the seven concepts not evaluated in detail in Level 3) to determine which combinations of improvements are most appropriate to address specific project needs.

Brief descriptions of the project alternatives are provided in the Refinement of Concepts Between the Level 1 and Level 2 Evaluations section of this document (see page 47) and for the recommended alternatives can be found in Figure 20, Figure 21, Figure 22, Figure 23, Figure 24, and Figure 25. Additional information and description about alternatives can be found in Attachment B, **Alternatives Evaluation Technical Report**.

Recommended Alternatives

Bring the Corridor to Standard Alternative

Much of the existing I-25 corridor has substandard geometric elements, including shoulder widths, roadway curvature, stopping sight distance, and ramp spacing. This alternative proposes to address the defined deficiencies identified in the *Existing Conditions Assessment Report* (Attachment A) by providing all necessary geometric improvements to the highway to meet FHWA Controlling Criteria engineering standards for the Interstate Highway System.

Figure 20 and Figure 21 in Chapter 3 provide an overview of this alternative.

The prevailing cross section of this alternative is four general-purpose lanes, not including acceleration and deceleration lanes, with full-width inside and outside shoulders in each direction. In addition to the transportation network changes in the No Action Alternative, improvements provided in this alternative include:

- Full-width inside and outside shoulders on the mainline
- Standard-width travel lanes
- Sufficient stopping sight distance
- Increased space between interstate access locations
- Standard acceleration and deceleration lanes at all ramps
- Revision of the mainline alignment to reduce curves on I-25
- Reconstruction of bridge structures to address height clearance issues and accommodate the widening of I-25

Collector/Distributor Roads and Braided Ramps Alternative

This alternative includes all geometric improvements (e.g., shoulder width, mainline alignment, etc.) proposed in the Bring the Corridor to Standard Alternative and proposes new collector/distributor roads to be constructed along each side of I-25 from 20th Street to Santa Fe Drive/US 85 in conjunction with braided ramps to allow for management of access to/from I-25. A list of the general improvements provided in this alternative is provided below.

Figure 22 and Figure 23 in Chapter 3 provide an overview of this alternative.

- All improvements included in the No Action Alternative
- All geometric improvements provided in the Bring the Corridor to Standard Alternative
- Collector/distributor roads
  - Northbound
    - Santa Fe Drive/US 85 to US 6/6th Avenue
    - US 6/6th Avenue to Colfax Avenue/Auraria Parkway
    - 23rd Avenue to 20th Street
  - Southbound
    - 20th Street to 17th Avenue
    - Colfax Avenue/Auraria Parkway/Lower Colfax Avenue to US 6/6th Avenue
    - US 6/6th Avenue to Santa Fe Drive/US 85
- Braided Ramps
  - Northbound
    - Between the Santa Fe Drive/US 85 to US 6/6th Avenue collector/distributor road on-ramp to northbound I-25 and the northbound I-25 off-ramp to US 6/6th Avenue
    - Between the northbound I-25 off-ramp to the US 6/6th Avenue to Colfax Avenue/Auraria Parkway collector/distributor road and the US 6/6th Avenue on-ramp to northbound I-25
    - Between the Colfax Avenue on-ramp to northbound I-25 and the northbound I-25 off-ramp to the 23rd Avenue to 20th Street collector/distributor road
    - Between the Speer Boulevard on-ramp to northbound I-25 and the 23rd Avenue to 20th Street collector/distributor road
  - Southbound
    - Between the Speer Boulevard on-ramp to the southbound 20th Street to 17th Avenue collector/distributor road and the 20th Street to 17th Avenue collector/distributor road off-ramp to 23rd Avenue
    - Between the 23rd Avenue to 17th Avenue collector/distributor road on-ramp to southbound I-25 and the southbound I-25 off-ramp to the Colfax Avenue to US 6/6th Avenue collector/distributor road
    - Between the Colfax Avenue, Auraria Parkway, and Lower Colfax Avenue on-ramps to southbound I-25 and the Colfax Avenue to US 6/6th Avenue collector/distributor road
    - Between the US 6/6th Avenue on-ramp to southbound I-25 and the southbound I-25 off-ramp to the US 6/6th Avenue to Santa Fe Drive/US 85 collector/distributor road

Managed Lanes Alternative

This alternative proposes new managed lanes along I-25 consistent with CDOT's HPTE *Express Lanes Master Plan* (CDOT/HPTE, 2020). The managed lanes are proposed to extend from approximately Santa Fe Drive/US 85 to the existing reversible managed lanes, north of 20th Street, running in both the northbound and southbound directions. In addition to adding managed lanes, this alternative also would include geometric improvements provided in the Bring the Corridor to Standard Alternative, and some of the collector/distributor roads and braided ramps proposed in the Collector/Distributor Roads and Braided Ramps Alternative. A list of the general improvements provided in this alternative is provided below.

Figure 24 and Figure 25 in Chapter 3 provide an overview of this alternative.

- All improvements included in the No Action Alternative
- All geometric improvements provided in the Bring the Corridor to Standard Alternative
- One new managed lane in both the northbound and southbound directions from the existing managed lanes near 20th Street to approximately Santa Fe Drive/US 85.
- Direct connection ramps from the managed lanes to crossing roadway facilities at the following locations:
  - Northbound
    - Eastbound and westbound US 6/6th Avenue on-ramp to the northbound I-25 managed lane
    - Northbound I-25 managed lane off-ramp to Colfax Avenue and Auraria Parkway
  - Southbound
    - Auraria Parkway on-ramp to the southbound I-25 managed lane
    - Speer Boulevard on-/off-ramp to/from the managed lanes to the north. This ramp was modeled as a reversible ramp serving southbound I-25 managed lane off-ramp traffic to Speer Boulevard during the AM peak period and then serving Speer Boulevard on-ramp traffic to the northbound I-25 managed lane during the PM peak period.
- Northbound collector/distributor road from 23rd Avenue to 20th Street
- Southbound collector/distributor road from 20th Street to Speer Boulevard

Although this alternative's defining characteristic in the implementation of managed lanes, note that this alternative is intended to more generally reflect the potential impacts of overall increased capacity on I-25. This capacity could be achieved through either the implementation of managed lanes and/or the implementation of general-purpose lanes.

Additional Opportunities and Segment-Specific Opportunities

In addition to the projects that make up the three recommended alternatives, other potential improvements identified as "Additional Opportunities" and "Segment-Specific Opportunities" were developed and documented in Level 2 analysis. Although these improvements were not specifically part of the three recommended alternatives, they were not eliminated and remain viable as potential corridor improvements (see Figure 26 in Chapter 3). These improvements include:

- Congestion pricing
- Operational and demand management
- New transit facilities
- Shoulder lane use
- Lane conversion
- Realigning and/or splitting the corridor
- Multi-level highway

Partnering on Future Projects

In addition, partner agency goals also should be considered when CDOT's I-25 corridor improvements are further developed. Certain partner agency projects or enhancements to I-25 improvements potentially could be designed and built in conjunction with the I-25 corridor improvements. For example,

a long-term capacity need of RTD is the addition of two additional light rail tracks between I-25 and Broadway and the Colfax Junction. In another example, Denver expressed a desire to provide additional connectivity across I-25 by covering part of the freeway with a lid. Denver also has indicated a desire to add or improve multimodal crossings, including the three identified in Figure 36, as well as other locations along the corridor. Each of these types of partner agency projects has the potential to improve mobility in and around the corridor and may result in cost efficiencies if constructed in conjunction with I-25 improvements. Partner agencies would most likely be expected to provide resources to support the additional analysis, design, and construction of those additional projects.

As funding becomes available, CDOT can mix and match the individual projects, the additional seven concepts from Level 2, and partner agency projects to develop projects and move them forward through environmental clearance and design, and ultimately into construction. This will allow CDOT to fully implement the identified improvements over time.

A project can move into a NEPA process when funding has been identified. The environmental process will take into consideration the environmental analysis and public and agency outreach conducted during this PEL Study.

What are potential individual projects and Early Action projects?

The corridor was divided into three logical segments: South, Central, and North.

- South Segment: South Santa Fe Drive/US 85 to US 6/6th Avenue
- Central Segment: US 6/6th Avenue to Colfax Avenue
- North Segment: Colfax Avenue to 20th Street

Individual projects were identified within each segment that could be advanced as discrete sets of improvements with independent utility so they could individually be moved forward into the NEPA process. If sufficient funding is available, it is possible for multiple improvements to be combined into a single NEPA analysis to implement more robust packages of improvements. For example, projects within the South and Central segments could be combined into a single NEPA analysis for a construction project between Santa Fe Drive/US 85 and Colfax Avenue. This combining of projects could potentially provide an overall cost savings.

The sections below describe the individual projects and elements within each segment, in no particular order, and whether they are part of a Level 3 alternative. Further detail about the project elements are provided in Chapter 3. Early Action projects also are described for each segment and for the corridor. These are projects that would improve operations and safety and are simpler to implement in the short term, even if they may eventually be removed during construction of longer-term improvements.

South Segment

This segment of I-25 is constrained between the South Platte River on the west and the CML railroad tracks on the east. Through the forum of the PEL Study, the stakeholders agreed the South Platte River is a high-value resource in the corridor and impacts to this resource should be avoided. However, there is a possibility of relocating the South Platte River Trail from the east bank of the river to the west bank to improve the trail environment, as supported by Denver, and allow for some minor highway improvements in that area.

Early Action

If the trail is realigned to the west side of the river, an Early Action safety project could be the reconstruction of the ramp for US 6/6th Avenue entering southbound I-25 to improve the shoulders and merge/weave configuration.

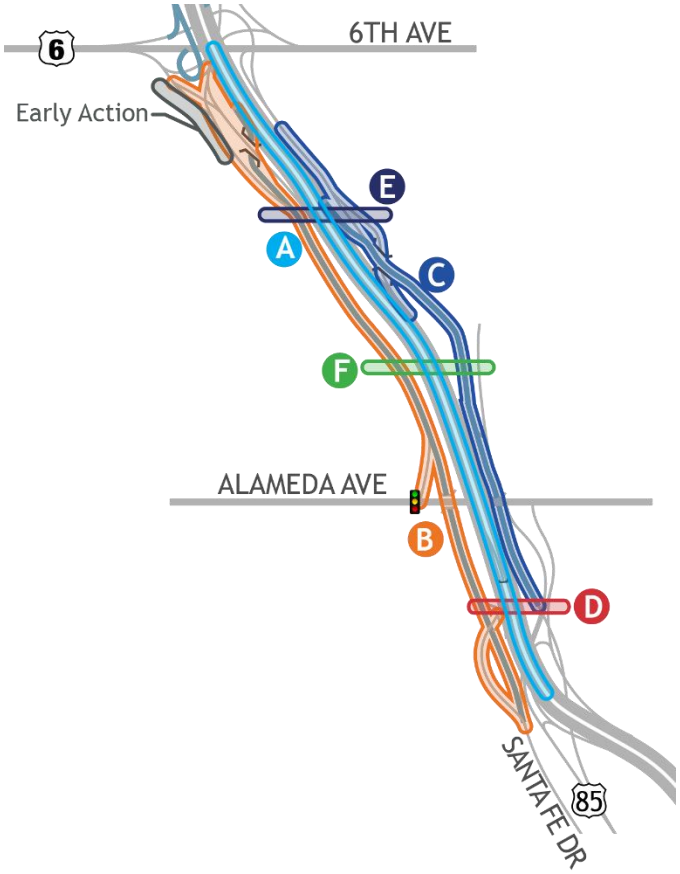


Table 15 South Segment: Santa Fe Drive/US 85 to US 6/6th Avenue

ID	Individual Project	Description	Alternative			Early Action
			BCTS	CD/BR	ML	
A	Managed lanes both directions	One managed lane between Santa Fe Dr/US 85 and US 6/6th Ave in both directions			x	
B	Southbound ramp improvements	Standard acceleration and deceleration lanes	x	x	x	
		Braided ramps between US 6/6th Ave and Santa Fe Dr/US 85		x		
		Collector/distributor road from US 6/6th Ave to Santa Fe Dr/US 85		x		
C	Northbound ramp improvements	Standard acceleration and deceleration lanes	x		x	
		Braided ramps between Santa Fe Dr/US 85 and US 6/6th Ave		x		
		Collector/distributor road from to Santa Fe Dr to US 6/6th Ave		x		

Table 15 South Segment: Santa Fe Drive/US 85 to US 6/6th Avenue

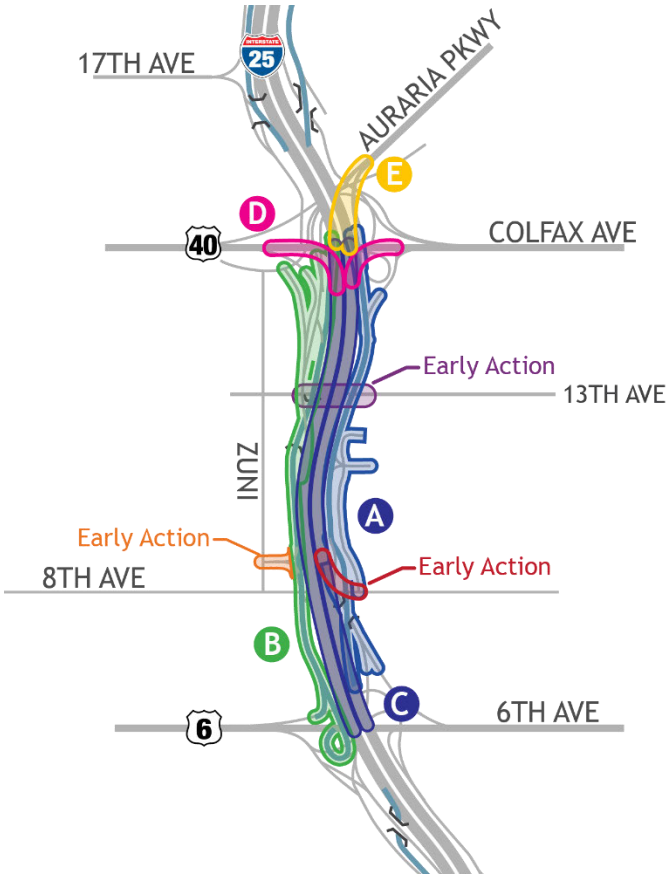
ID	Individual Project	Description	Alternative			Early Action
			BCTS	CD/BR	ML	
D	Bicycle/pedestrian bridge at W Virginia Ave	Bicycle/pedestrian bridge crossing I-25 at W Virginia Ave	x	x	x	
E	Local road over I-25 at 3rd Ave	Local road over I-25 at 3rd Ave	x	x	x	
F	Bicycle/pedestrian bridge at Bayaud Ave	Bicycle/pedestrian bridge crossing I-25 at Bayaud Ave	x	x	x	
	Trail realignment near US 6/6th Ave and ramp reconstruction	US 6/6th Ave southbound on-ramp reconstruction after trail realignment				x

Notes: "BCTS" = Bring the Corridor to Standard Alternative, "CD/BR" = Collector/Distributor Roads and Braided Ramps Alternative, "ML" = Managed Lane Alternative

Central Segment

The local grid network surrounding I-25 is fragmented between Colfax Avenue and US 6/6th Avenue. This results in over-reliance on the I-25 facility for many local trips. This segment serves high traffic volume movements between the US 6/6th Avenue ramps and the Colfax Avenue/Auraria Parkway ramps.

The most important first step in this area is to improve the northbound ramps between US 6/6th Avenue and Colfax Avenue/Auraria Parkway.



Early Action

An Early Action safety improvement could be to close the northbound on-ramp at 8th Avenue and reconstruct the ramp for US 6/6th Avenue entering northbound I-25 to improve the shoulders and merge/weave configuration. Similar improvements could be made an Early Action project by closing the 8th Avenue on- and off-ramps on southbound I-25. Both actions would require additional analysis and stakeholder outreach to understand how traffic using those ramps would be diverted. A third Early Action project could be to improve the bicycle and pedestrian facilities on 13th Avenue under I-25 in coordination with Denver.

Table 16 Central Segment: US 6/6th Avenue to Colfax Avenue

ID	Individual Project	Description	Alternative			Early Action
			BCTS	CD/BR	ML	
A	Northbound ramp improvements	Standard acceleration and deceleration lanes	x	x	x	
B	Southbound ramp improvements	Braided ramps between US 6/6th Ave and Colfax Ave		x		
		Collector/distributor road from US 6/6th Ave to Colfax		x		
		Standard acceleration and deceleration lanes	x		x	

Table 16 Central Segment: US 6/6th Avenue to Colfax Avenue

ID	Individual Project	Description	Alternative			Early Action
			BCTS	CD/BR	ML	
C	Managed lanes in both directions	Braided ramps between Colfax Ave and US 6/6th Ave		x		
		Collector/distributor road from Colfax to US 6/6th Ave		x		
		One managed lane between US 6/6th Ave and Colfax Avenue in both directions			x	
D	Managed lane direct connection at Colfax Ave	Managed lane direct connection to/from Colfax Ave			x	
E	Managed lane direct connection at Auraria Pkwy	Managed lane direct connection to/from Auraria Pkwy			x	
	Northbound 8th Ave on-ramp	Closure of on-ramp				x
	Southbound 8th Ave on- and off-ramps	Closure of on-ramp and off-ramp				x
	13th Ave undercrossing	Crossing improvements				x

Notes: "BCTS" = Bring the Corridor to Standard Alternative, "CD/BR" = Collector/Distributor Roads and Braided Ramps Alternative, "ML" = Managed Lane Alternative

North Segment

North of Speer Boulevard, this segment of I-25 is highly constrained between developed properties. At the Speer Boulevard interchange and to the south, I-25 is constrained by a historic building, park property on the east, and the Children's Museum. There are parking lots in the vicinity that may provide development opportunities; therefore, transportation improvement decisions need to be made soon.

The most important first step in this area is to replace the 23rd Avenue and Speer Boulevard bridges, since they are near the end of their useful life and are often struck by trucks due to deficient vertical clearance.

Early Action

An Early Action project could be to improve the merge/weave movements for northbound traffic between Colfax Avenue and 23rd Avenue by closing the northbound 17th Avenue ramps—or only allowing access when Empower Field at Mile High Stadium is hosting events. This would require additional analysis and stakeholder outreach to understand how traffic using that ramp would be diverted.

Table 17 North Segment: Colfax Avenue to 20th Street

ID	Individual Project	Description	Alternative			Early Action
			BCTS	CD/BR	ML	
A	23rd Ave and Speer Blvd Bridges	Bridge replacement	x	x	x	
B	Managed lanes between 20th St and Speer Blvd	One managed lane in each direction between 20th St and Speer Blvd with a direct connection to Speer Blvd			x	
		Standard acceleration and deceleration lanes	x		x	
		Braided ramps between Colfax Ave and 23rd Ave		x		

Table 17 North Segment: Colfax Avenue to 20th Street

ID	Individual Project	Description	Alternative			Early Action
			BCTS	CD/BR	ML	
C	Northbound ramp improvements from Colfax Ave to Speer Blvd	Standard acceleration and deceleration lanes	x		x	
		Braided ramps between Colfax Ave and 23rd Ave		x		
D	Northbound ramp improvements from Speer Blvd to 20th St	Standard acceleration and deceleration lanes	x		x	
		Braided ramps between Speer Blvd and 20th St		x		
		Collector/distributor road from 23rd Ave to 20th St	x	x	x	
E	Managed lanes between Colfax Ave and Speer Blvd	One managed lane in both directions between Colfax Ave and Speer Blvd			x	
F	Southbound ramp improvements from 20th St to Speer Blvd	Standard acceleration and deceleration lanes	x			
		Braided ramps between Speer Blvd and 23rd Ave		x		
		Collector/distributor road from 20th St and Speer Blvd	x	x	x	
G	Southbound ramp improvements from Speer Blvd to Colfax Ave	Standard acceleration and deceleration lanes	x		x	
		Braided ramps between 23rd Ave and Colfax Ave		x		
	Northbound 17th Ave on-and off-ramps	Closure of on-ramp and off-ramp, except possibly during stadium events				x

Notes: "BCTS" = Bring the Corridor to Standard Alternative, "CD/BR" = Collector/Distributor Roads and Braided Ramps Alternative, "ML" = Managed Lane Alternative

Corridor-Wide

There are two corridor-wide Early Action projects to improve congestion and safety that can be easily implemented in the short term. These include creating a comprehensive traffic incident management plan (TIMP) and developing proactive TDM programs.

- I-25 Central Corridor TIMP: Currently, the corridor does not have a focused TIMP. Response to incidents falls within two different areas that are divided at US 6/6th Avenue. A formalized TIMP that is comprehensive for the whole corridor would improve safety and operations.
- TDM Programs: Coordination with Denver and DRCOG on developing a comprehensive suite of TDM strategies, programs, and initiatives could help address travel demand from future planned developments adjacent to the I-25 Central corridor.

The TDM program for the I-25 Central corridor could include, but is not limited to, the following strategies:

- Carpool and vanpool programs
- Guaranteed Ride Home
- ITS and Traveler Information Systems
- Mobility hubs
- Rideshare matching
- Shared ridehailing
- Telecommuting
- Variable work hours

Many of these strategies focused on the I-25 Central corridor can be coordinated with DRCOG's Way to Go program.

What are the merits of the individual projects?

The individual projects were evaluated using the I-25 Central PEL criteria developed for the study (see the Development and Evaluation of Alternatives chapter of this PEL report). Qualitative "High," "Medium," and "Low" comparative ratings were assigned to these project elements based on the findings of the *Existing Conditions Assessment Report* (Attachment A) and the alternatives evaluation. A high rating indicates the project addresses the criteria well with more benefits and/or fewer negative impacts. Conversely, a low rating signifies the project has relatively few benefits, more negative impacts, or has challenges to implement. Table 18 describes the qualitative criteria ratings. In some segments, the specific benefits and impacts differ between alternatives, but for the purposes of simplicity the benefits and impacts were generalized between alternatives.

The following symbols, shown in Table 19, indicate how the project addresses each criterion:


HIGH: Addresses the criterion well


MEDIUM: Addresses the criterion okay


LOW: Addresses the criterion poorly

Table 19 lists the projects in random order and displays the comparative evaluation results. These results show that implementing improvements that benefit the corridor will encounter many challenges, since I-25 is in a heavily built environment along a historical riparian corridor through central Denver. Some key observations of the comparative evaluation include:

- Ramp improvements have high benefits to safety and congestion but in the Central and North segments the benefits are offset by the need to close accesses; ramp improvements also have impacts to the social and built environments
- Managed lanes provide travel time reliability benefits
- New crossings, while providing an east-west mobility benefit, do not directly address the primary corridor needs of safety and congestion on I-25

Table 18 Qualitative Criteria Ratings

Criteria	High	Medium	Low
Safety	Reduces height clearance issues, improves geometrics, accommodates incident management, reduces secondary crashes, or reduces conflict points on I-25 or its ramps	Partially addresses height clearance issues, geometrics, incident management, secondary crashes, or conflict points on I-25 or its ramps	Does not notably address height clearance issues, geometrics, incident management, secondary crashes, or conflict points on I-25 or its ramps
Congestion	Increases capacity, reduces turbulence, or demand (i.e., remove short trips) on I-25	Partially increases capacity, reduces turbulence, or demand on I-25	Does not notably address capacity, turbulence, or demand on I-25
Travel Time Reliability	Provides a guarantee of travel time or improves flexibility to respond to incidents / short term variations in travel demand	Partially guarantees travel time or flexibility	Does not guarantee travel time or improve flexibility to respond to incidents / short term variations in travel demand
Access	Improves quantity or quality of access, or adequately addresses access to surrounding land uses	Moderately addresses quantity or quality of access, or adequately addresses access to surrounding land uses	Does not address quantity or quality of access, or access to surrounding land uses
Environment	Minimal impacts to natural, social, and built environments and requires minimal ROW	Moderate impacts to natural, social, and built environments and requires moderate ROW	Has impacts to natural, social, and built environments and requires ROW
Crossings	Improves connectivity across I-25 for bicyclists, pedestrians, transit, and vehicles	Improves connectivity across I-25 for bicyclists, pedestrians, transit, and vehicles	Does not address connectivity across I-25 for bicyclists, pedestrians, transit, and vehicles
Constructability	Does not have extraordinary construction/maintenance costs, or does not require substantial coordination	Has moderate construction/maintenance costs, or requires moderate coordination	Has extraordinary construction/maintenance costs, or requires substantial coordination
Future Flexibility	Could accommodate future physical changes (restriping, new lane assignments, new technology, etc)	Could accommodate future physical changes moderately well	Would not accommodate future physical changes

Table 19 Project Benefits and Impacts

ID	Project Name	Safety	Congestion	Travel Time Reliability	Access	Environment	Crossings	Constructability	Future Flexibility
South Segment: South Santa Fe Drive/US 85 to US 6/6th Avenue									
A	Managed lanes both directions	●	✓	✓	●	●	—	—	✓
B	Southbound ramp improvements	✓	✓	●	✓	●	—	●	—
C	Northbound ramp improvements	✓	✓	●	✓	●	—	●	—
D	Bicycle/pedestrian bridge at W Virginia Ave	✓	●	NA	NA	✓	✓	✓	—
E	Local road over I-25 at W 3rd Ave	✓	●	NA	NA	✓	✓	✓	—
F	Bicycle/pedestrian bridge at W Bayaud Ave	✓	●	NA	NA	✓	✓	✓	—
Central Segment: US 6/6th Avenue to Colfax Avenue									
A	Northbound ramp improvements	✓	✓	●	●	—	—	●	—
B	Southbound ramp improvements	✓	✓	●	●	—	—	●	—
C	Managed lanes both directions	●	✓	✓	●	—	—	—	✓
D	Managed lane direct connection at Colfax Ave	●	●	✓	✓	●	—	—	✓
E	Managed lane direct connection to/from Auraria Parkway	●	●	✓	✓	●	—	●	✓

Table 19 Project Benefits and Impacts

ID	Project Name	Safety	Congestion	Travel Time Reliability	Access	Environment	Crossings	Constructability	Future Flexibility
North Segment: Colfax Avenue to 20th Street									
A	23rd Ave and Speer Blvd bridges	✓	–	–	–	✓	✓	●	●
B	Managed lanes between 20th St and Speer Blvd	●	✓	✓	●	●	–	–	✓
C	Northbound ramp improvements from Colfax Ave to Speer Blvd	✓	✓	●	●	–	–	●	–
D	Northbound ramp improvements from Speer Blvd to 20th St	✓	✓	●	✓	–	–	●	–
E	Managed lanes between Colfax Ave and Speer Blvd	●	✓	✓	●	–	–	–	✓
F	23rd Ave and Speer Blvd bridges	✓	–	–	–	✓	✓	●	●
G	Southbound ramp improvements from Speer Blvd to Colfax Ave	●	✓	✓	●	●	–	–	✓

What are the estimated costs of the project?

*Assumptions used to estimate project costs are provided in Attachment F, **Project Cost Estimate Assumptions**.*

Construction cost estimates were prepared in three ways.

Table 20 shows the cost to construct each alternative for the entire corridor *based on the preliminary conceptual designs of the alternative,* and those costs include general ROW costs since the alternatives provide a basic footprint dimension. ROW acquisition costs for corridor-level alternatives were determined based on an estimate of the impacted parcel area and a corresponding cost based on land use type—an appropriate level of estimation for a PEL study. The corridor cost estimates assume that the entire corridor is constructed at one time.

Table 20 Cost Estimates by Alternative (in millions)

Cost Item	Bring the Corridor to Standard	Collector/Distributor Roads and Braided Ramps	Managed Lanes
Construction Items	$700 to $860	$1,150 to $1,410	$1,180 to $1,440
ROW	$100 to $125	$335 to $360	$325 to $350
Total Cost	**$800 to $985**	**$1,485 to $1,770**	**$1,505 to $1,475**

Note: Assumptions used to estimate project costs are provided in Attachment F.

Table 21 shows individual project costs. The individual project costs include all reasonable features necessary to complete them as discreet projects and, as such, there are elements of those projects that are redundant (e.g., bridge replacement). Due to the redundant elements across individual projects, the total project cost is not additive.

The individual project cost estimates do not include ROW costs since specific project details are not provided for any individual project because additional design and analysis is required to determine limits of construction and any potential acquisition costs associated with the project-level improvements.

Table 21 Cost Estimates by Alternative for Individual Projects (in millions)

Project	Bring the Corridor to Standard	Collector/Distributor Roads and Braided Ramps	Managed Lanes
South (Santa Fe Drive/US 85 to US 6/6th Avenue)			
Northbound Ramp Upgrades	$0	$8 to $10	< $5
Southbound Ramp Upgrades	$0	$125 to $155	$0
Mainline Widening and Shoulder Improvements	$170 to $205	$175 to $215	$240 to $295
Central (US 6/6th Avenue to Colfax Avenue)			
Northbound Ramp Upgrades	< $5	$195 to $240	< $5
Southbound Ramp Upgrades	$50 to $60	$225 to $275	$35 to $40
Mainline Widening and Shoulder Improvements	$205 to $250	$230 to $280	$240 to $295

Table 21 Cost Estimates by Alternative for Individual Projects (in millions)

Project	Bring the Corridor to Standard	Collector/Distributor Roads and Braided Ramps	Managed Lanes
North (Colfax Avenue to 20th Street)			
Northbound Ramp Upgrades	$10 to $15	$120 to $150	$65 to $80
Southbound Ramp Upgrades	$30 to $40	$175 to $210	$65 to $80
Mainline Widening and Shoulder Improvements	$175 to $210	$175 to $215	$205 to $250
Replace 23rd/Speer Bridges	$65 to $80	$80 to $95	$125 to $155

Note: Assumptions used to estimate project costs are provided in Attachment F, this table does not include ROW costs. Project lengths vary by alternative based on area necessary to construct improvements.

Table 22 shows project costs to construct managed lanes between discrete geographic areas (as indicated in the table). The individual project costs include all reasonable features necessary to complete them as discrete projects. This assumes the full managed lane buildout for the discrete geographic area, which includes mainline improvements. There are a few elements of each discrete project that are redundant (e.g., direct connects). Due to the redundant elements across individual projects, the total project cost is not additive.

The individual project cost estimates do not include ROW costs since specific project details are unknown and it is unclear exactly what ROW would be needed since it is not known what projects may be completed before, after, or with the individual project.

Table 22 Cost Estimates for Individual Managed Lanes Projects (in millions)

Project	Managed Lanes
Managed Lanes (20th Street to Speer Boulevard)	$235 to $285
Managed Lanes (US 6/6th Avenue to Speer Boulevard)	$770 to $940
Managed Lanes (Santa Fe Drive/US 85 to US 6/6th Avenue)	$220 to $270
Managed Lane direct connect to Colfax Avenue and Auraria Parkway	$295 to $360
Managed Lane direct connect for E/W US 6/6th Avenue to northbound I-25	$250 to $305

Note: Assumptions used to estimate project costs are provided in Attachment F, this table does not include ROW costs.

What are the phasing considerations?

CDOT is planning to immediately address the deficient bridge structures at 23rd Avenue and Speer Boulevard. Beyond that point, it is important to acknowledge that an upcoming fundamental decision for the corridor affects potential project sequencing. This major decision is if and how to implement managed lanes in the I-25 Central corridor. Extending from this decision, many iterations of improvement sequencing is possible, which will depend largely on the amount of funding available and the type of improvements that are prioritized. As Table 19 shows, individual projects address safety, congestion, and the other project goals differently. Phasing will depend on the priorities and the available funding.

What are the next steps?

The PEL is recommending three alternatives for consideration in future NEPA processes. None of the three alternatives can individually address all of the needs of the corridor. A future NEPA process will need to consider the elements of all three alternatives (plus those elements carried forward but not evaluated in detail in Level 3 and potential enhancements) to determine which combination of improvements is most appropriate to address specific project needs.

The next steps of analysis are likely to include:

- A NEPA and design study focused on the Speer Boulevard and 23rd Avenue bridge replacements
- A Level 2 traffic and revenue study to determine the potential of adding managed lanes to the entire study area
- An Express Lane Study (US 36 to 20th Street) to determine the viability of converting the reversible lane to a bi-directional facility

Many of the individual projects, project elements, and Early Action projects lend themselves to collaborative efforts between stakeholder partners. During subsequent NEPA studies, opportunities for funding partnerships will be sought. Potential partners include Denver, RTD, The Greenway Foundation, and the major districts and large property owners along the corridor.

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